WATERSHED ASSESSMENT

for

UPPER TYGART VALLEY

DOCUMENTATION FOR PORTIONS OF OPPORTUNITY AREAS:

CHESTNUT RIDGE OA# 36.106

UPPER TYGART VALLEY OA# 36.118

GREENBRIER RANGER DISTRICT

MONONGAHELA NATIONAL FOREST

Introduction

Intent of Watershed Analysis

A watershed analysis, as applied on the Monongahela National Forest (MNF), is a procedure to identify the interactions, processes, and functions of resources such as water, soils, plants, trees, animals, and human influence on a watershed scale. Knowing and better understanding these relationships will help us set priorities for social, economic and ecological needs when planning future activities in the area. It will also help us to better determine the effects of our management. The watershed scale was chosen because it is a well-defined land area having unique features, and it allows us to analyze the interrelationships of various resources in an entire watershed.

The watershed assessment sets the stage for future project analyses; it does not result in a decision. It is designed to allow for future changes based on new information and data that become available or as other issues develop. This report covers six basic steps:

- Characteristics of the watershed – the dominant physical, biological, and human processes.
- Issue identification with key questions – the main resource concerns, conditions, and activities.
- Reference condition description – establishes the historical uses and health of the identified resources and serves as a comparison to the current condition.
- Current condition description – describes the health or existing state of identified resources as they relate to the issues.
- Interpretation of the changed conditions and probable causes – summarizes the main findings of the previous steps and explains the significance of any changes.
- Management activity recommendations – outlines potential projects to maintain or restore the health of the identified resources within the framework of the MNF Land and Resource Management Plan (Forest Plan) management prescriptions (MPs). The objective is to move the area toward a Desired Future Condition (DFC) using standards and guidelines described in the MPs.

The findings within this document serve as a foundation to develop site-specific project proposals, associated effects analysis, and decision documents.

Chapter 1 - Characterization

Characterization of the Upper Tygart Valley Watershed

The majority of the Upper Tygart Valley watershed is within Randolph County with a small portion along the southern boundary at the head of the Tygart Valley River in Pocahontas County. The headwaters of the Tygart Valley River begin approximately 1.3 miles southeast of the Randolph/Pocahontas County line. The eastern boundary is along Cheat Mountain with the northern boundary located just north of the town of Mill Creek at the confluence of Mill Creek and Tygart Valley River (includes the Right Fork Mill Creek sub-watershed). The western boundary is along Rich Mountain continuing south to Elk Mountain. Elk Mountain and Valley Mountain connect to Cheat Mountain to form the southern boundary. The Tygart Valley River flows into the Monongahela River, and joins the Allegheny River at Pittsburgh, PA to form the Ohio River. The Upper Tygart Valley itself is a V-shaped valley between one-half and one and a half miles wide, while smaller stream valleys in the project area are V-shaped with narrow floors, leading to small, discontinuous and narrow floodplains. Slopes leading up to ridge summits are steep, ranging between 3 and 80 percent.

The Upper Tygart Valley watershed covers approximately 96,691 acres (151 sq. mi.). National Forest System (NFS) land in this watershed is on the Greenbrier Ranger District and encompasses 16,617 acres, private land covers approximately 68,451 acres, and state owned land includes about 11,623 acres. State owned land includes the Kumbrabow State Forest (about 6,973 acres in this watershed), Becky Creek Wildlife Management Area (WMA) contains approximately 1,930 acres, and Huttonsville State Farm WMA has about 2,720 acres. Kumbrabow State Forest is managed by the WV Division of Forestry. Becky Creek and Huttonsville State Farm WMAs are managed by the WV Department of Natural Resources.

The assessment area is a fifth order watershed (#0502000101, using Natural Resource Conservation Service system) and includes five sixth order sub-watersheds:

- Becky Creek
- Upper Tygart Composite
- Mill Creek
- Tygart Composite 1
- Tygart Composite 2

Elevations range from 2,000′ at the confluence of Tygart Valley River with Mill Creek just north of the town of Mill Creek to 4,743′ at an unnamed knob on Cheat Mountain in the southeast corner of the watershed. The climate is characterized by average precipitation of about 45″ per year (measured at Elkins, WV). Typically the average precipitation is higher in the higher elevations. The wettest year recorded in Elkins, WV was 1996 with 72.88″ of precipitation and the driest year was 1930 with 28.38″ of precipitation. The average annual temperature for Elkins, WV is 49.1°F with an average

summer temperature of 67.9°F and an average winter temperature of 31.0°F. Extreme temperatures in Elkins, WV range from a record high of 99°F on July 16, 1988 and August 6, 1918 to a record low of -24°F on December 23, 1989 and January 20, 1984. The most extreme cold temperatures in West Virginia were recorded in Lewisburg, WV at -37°F on December 30, 1917 and -36°F at Snowshoe, WV on January 21, 1985. Record annual snowfall in West Virginia occurred in Kumbrabow State Forest (301.4 inches) during the 1959/60 winter with Snowshoe, WV recording the greatest uniform depth at 62 inches on March 8, 1978 and Pickens, WV recording the greatest snow amount during a single storm (57 inches) from November 24-29, 1950 (National Weather Service, 2002).

In general, the watershed is located in the Appalachian Plateau geomorphic province. It is a maturely dissected plateau characterized by high, sharp ridges, and low mountains, and narrow valleys. It has a prominent structural and topographic grain created by a broad, northeast to southwest trending folds in the bedrock. Generally, throughout this watershed, high areas are capped with Pottsville Group (Gp), valley side slopes are exposed Mississippian and the valley floor is exposed upper Devonian. Recent alluvial deposits have collected along major stream channels predominantly along the broad flat valley floor. The older Devonian rocks that are dominant in this watershed area comprise 100 percent of the valley floor and about 60 percent of the entire watershed area. A relatively narrow rim of Pennsylvanian and Mississippian rocks rings the watershed area in a 'U' shaped pattern. There is a general thickening of the Mauch Chunk rock layers in the southern end of the watershed. Drainage is dendritic to trellis, but primarily dendritic. (McNab, pg. 18-2)

The watershed contains all or parts of four opportunity areas (OAs) under one MP as described in the Forest Plan. Table 1.1 lists the OAs and management prescriptions with percentage of acreage in the watershed.

Table 1.1 – Distribution of Management Prescriptions and Opportunity Areas

OA #	OA Name	MP	NFS Acres	Total Acres	% of NFS land in watershed	% of All land in watershed
36.106	Chestnut Ridge	6.1	3859	8,686	4.0	9.0
36.107	Crouch Run	6.1	73	73	<0.1	<0.1
36.113	Stonecoal	6.1	155	155	0.2	0.2
36.118	Upper Tygart Valley	6.1	9500	39,262	9.8	40.6
36.119	Old Spruce	6.1	3030	3,043	3.1	3.2
***NONE**	*NONE	0	0	45,472	0	47
	Total		**16,617**	**96,691**	**17.2**	**100**

*Land is not in a designated OA or is outside of MNF proclamation boundary.

MP 6.1 emphasizes:

- Remote habitat for wildlife intolerant of disturbance.
- A semi-primitive and non-motorized type of recreational environment.
- A mix of forest products.
- A strategy for management of sites reverting from hardwood to conifer and the intermingled high site hardwood types.

Current conditions, reference conditions, desired conditions and objectives are described within each core topic. The core topics and sub-topics for this analysis are:

- Erosion Processes
  - Ecologic Land Types
  - Soils
  - Geology
- Air Quality
- Hydrology/Stream Channels
  - Morphology
  - Flow Rates
  - Storm Flows
- Water Quality
  - Sediment
  - Acidity (pH)
  - Temperature
- Aquatic Resources
  - Fish
  - Riparian Habitat
- Vegetation
  - Threatened/Endangered/Sensitive Flora
  - Forest Type/Size/Density
  - Agriculture/Openings
- Wildlife
  - Threatened/Endangered/Sensitive Fauna
  - Management Indicator & Emphasized Species
- Human Uses
  - Recreation
  - Minerals – Coal/Gas/Oil
  - Special Uses
  - Roads/Trails
  - Heritage Resources
  - Landlines
  - Private Land

Erosion Processes

Ecologic Land Types

Soils

Information for the soil resource is located in the County Soil Survey Reports for Pocahontas (1998) and Randolph Area, Main Part (1982) Counties. The USDA Natural Resource Conservation Service, Soil Survey, is the author of these documents in cooperation with the USDA Forest Service, West Virginia University Agricultural Experiment Station and local county authorities. The county soil survey report provides a map of the soil types (map units) at a scale of 1:24,000, soil map unit descriptions, typical soil series descriptions for the county, and soil map unit interpretations for various land management activities and soil properties. Soil characterization data for series used in this watershed is limited. However, because of the nature of soil survey and the principles on which soil is defined to form under, it is accepted that for large scale planning, soil characterization data for typical soil pedons from surrounding areas may be used to develop general analyses of soil chemistry and soil physical properties. Soil chemistry data for these typical pedons is stored in a National Soil Survey Center laboratory database. On a stand-by-stand basis, site-specific analysis should be done to address issues that are being put forth at that same scale. This may include an ocular survey of the stand or actual soil sampling within the stand on the various soil map units. A visual survey of the area can be completed by the Forest Soil Scientist or a survey crew with adequate experience in land resource management and a basic understanding of soil development principles. However, most detailed analyses of soil physical and chemical properties would require planning and funding to obtain lab data that would be interpreted by the Forest Soil Scientist and other Resource Specialists as needed.

Current analyses of the soil resource are conducted using the forest GIS database system and field visits to the watershed. A digital layer of the soils exists for 7 of 10 counties within the forest proclamation boundary. A digital layer depicting the sensitive soils is also available in the GIS database. Soils rated as sensitive require mitigation measures beyond those in the Forest Plan that are routinely applied during project implementation. Sensitive soils are grouped in the following categories: soils that are prone to mass wasting and/or slippage; slopes > 50 percent; prime farmland; hydric soils; flood plain soils; soils that form on limestone and karst topography; and soils that are moderately well drained or wetter.

Known discrepancies in the data are as follows:

- There are more acres of colluvial soils existing on the landscape than originally mapped. Many of these colluvial soils are mapped as residual soils.
- The concept of frigid soils was not used in the Randolph County Main Part Soil Survey. However, frigid soil concepts were used in the recent Pocahontas County Soil Survey. Therefore there are discrepancies in the soils data at the Randolph County Pocahontas County line as well as in the landtype association (LTA)

descriptions for the soil families in Ba01. This has relevance to habitat for vegetative communities like red spruce, nutrient cycling processes, and soil moisture.

- The soil series and concepts that were used for the mapping in 1982 for Randolph County Main Part Soil Survey were broader and more general than the current soil survey database for Pocahontas County. Therefore, it is possible the series and concepts used in this watershed analysis are over utilized across the landscape and extended beyond their suitability to describe the soils in the watershed.
- Also, it was thought that forest soils or soils on steeper slopes that were not utilized for agriculture did not have much value to a land owner and the level of intensity of mapping of forested soils was not as great as the level of mapping of soils in agricultural lands in the soil surveys.
- The GIS database does not contain the soil survey data for the entire Upper Tygart Valley watershed. Data was initially only brought into the database for information that was included within the Monongahela National Forest Proclamation Boundary. The GIS staff is currently working on bringing in the entire soil survey for Pocahontas County and Randolph County, Main Part.

Geology

The principal stratigraphy for the Upper Tygart Valley Watershed includes the lower Pennsylvanian Pottsville Group, the Mississippian and the top of the Devonian.

Pennsylvanian
Ck – Kanawha Formation
Cnr – New River Formation
} Pottsville Group

Mississippian
Cbl – Bluestone Formation
Cpr – Princeton Formation
Ch – Hinton Formation
Cbf – Bluefield Formation
} Mauch Chunk Group

Cgr – Greenbrier Group
Cmcc – Maccrady Formation
Cpo – Pocono Group

Devonian
Dh - Hampshire Formation
Dch - Chemung Group
Db - Brallier Formation

Generally throughout this watershed, high areas are capped with Pottsville Group, valley side slopes are exposed Mississippian and the valley floor is exposed upper Devonian. Recent alluvial deposits have collected along major stream channels predominantly along the generally broad flat valley floor. The older Devonian rocks that are dominant in this

watershed area comprise 100 percent of the valley floor and about 60 percent of the entire watershed area. Relatively narrow rims of Pennsylvanian and Mississippian rocks ring the watershed area in a 'U' shaped pattern. There is a general thickening of the Mauch Chunk rock layers in the southern end of the watershed.

The watershed sits in the transition of high to low plateau area of the Allegheny Plateau which is characterized as a medium energy, medium amplitude fold geometry containing small reverse fault displacements. Along the floor of the Tygart River Valley runs the trace of the Deer Park Anticline that runs nearly North/South. The Dear Park Anticline is bounded on the west by the Belington Syncline and on the East by the North Potomac (George Creek) Syncline. The rock strata are all dipping with respect to the Deer Park Anticline. Strata on the western side of the anticline are generally dipping more sharply than strata on the eastern side of the anticline. The Tygart Valley was formed by erosion along the axis of the Deer Park Anticline. (Reger, 1931)

Air Quality

Although the area is generally characterized by unstable air masses that move quickly through the area, early morning fog is not uncommon, particularly during the summer. These inversions usually are short lived; however, they provide additional moisture to the soils and vegetation. Local emission sources include residential wood burning, burning of slash and land clearing on private land, small local industries, and vehicular traffic.

Acid deposition in the form of sulfates (mainly from industrial emissions such as electric utilities) and nitrates (mainly from vehicle emissions) is causing acidification of soils and streams in the Upper Tygart Valley watershed. Acid precipitation develops when rain or snow mixes with the sulfate and nitrate gases or particulate matter in the atmosphere and enters the soils and streams. This acidification may have long-term negative impacts on the terrestrial and aquatic ecosystems.

Visual quality has been impaired by the increase of atmospheric sulfates (the largest contributor to haziness) in the Southern Appalachian Region. A limit on emissions from electric utility and industry sources required by the 1990 Clean Air Act should reduce sulfur dioxide emissions over the next several years (Southern Appalachian Man and the Biosphere 1996).

Hydrology/Stream Channels

Morphology

Streams within the watershed have developed in soils formed from geology consisting of primarily sandstone, siltstone, shale, Mauch Chunk formation, and some alluvial deposits. The terrain in this area consists of broad ridgetops and benches; steep to very steep hillsides; and strongly sloping to moderately steep foot slopes. Intermittent drainages frequently dissect the watershed. Bedrock is exposed on the surface in areas

and stones cover much of the landscape. The potential for soil erosion is severe in some locations. Sensitive soils are scattered throughout the watershed. Slope and the limited depth to bedrock are the main factors that limit management activities in this area.

Flow Rates

Stream flows within the watershed tend to be highly variable, dependent upon the season and precipitation patterns. Stream flow has been influenced by land uses in the Upper Tygart Valley Watershed. Timber harvest activities that remove more than 20 percent of the basal area in a watershed within one year may temporarily increase runoff rates. A decrease of evapotranspiration and modest increases in annual runoff could occur. As the trees regrow after harvesting, flow rates return to near normal within one year or so after a light thinning and within five to ten years after clearcutting (Patric 1984).

Storm Flows

Storm flows within the area are characterized as intense and frequent. Streams are flashy in their response to larger storms, especially the more intense storms. Streams tend to rise and fall rapidly under those conditions returning to base flow rather quickly. Major frontal weather systems and tropical storms from the south can carry substantial quantities of rainfall. The largest 24-hour rainfall event for this area that occurs once each year (on average) is about 2.5 inches. However, periodic storms occur with much greater amounts and intensities of rainfall. For example, the record rainfall amount within a 24-hour period in West Virginia occurred on July 18, 1889 with 19 inches recorded in Rockport, WV (National Weather Service 2002). Other less major storm events are fairly frequent, and generally occur during the dormant season of the year (November through mid-May), when evapotranspiration losses are minimal. This further adds to rapid storm runoff. Growing season storms and floods are not uncommon.

Water Quality

The portion of the Tygart Valley River in the Upper Tygart Valley watershed is a free-flowing river with no impoundments in the main channel. Tentative plans have been discussed to construct a dam in the Elkwater Fork, a tributary of the Tygart Valley River within this watershed, to provide a more stable water supply to local communities.

Water quality data and other information have been collected in the past within this watershed. Fieldwork was done in portions of the watershed to document stream and riparian conditions, and to identify sources of erosion and stream sedimentation. This data is presently maintained by the Monongahela National Forest aquatics personnel in the Forest Supervisors office in Elkins, WV.

Sediment

Water quality concerns are usually associated with sedimentation of streams, water temperature, and pH. Some human use factors causing sedimentation in the Upper Tygart Valley watershed are home and industrial sites, mining, agriculture, grazing, logging, and the associated network of private, state, and federal roads. In a study on the Fernow Experimental Forest near Parsons, WV using West Virginia Best Management Practices with conventional logging equipment, sediment export during timber harvest activities doubled in the first year the area was logged. In that study, sediment export levels returned to normal by the third year following completion of timber harvesting. Projected long term sediment export from three entries during a 100 year period for logging operations indicated less than five percent of the total sediment export would be from timber harvest activities (Kochenderfer, Edwards, and Wood 1997).

Fine sediment levels within the streams that form the sub-watersheds are variable. No data is available for fine sediment on streams within private lands, and only limited observations of fine sediment conditions in streams within the National Forest System were made for this assessment. Within streams on private lands, fine sediment levels are likely fairly high, but this has not been substantiated. High levels of fine sediment would be expected based on the nature of land management on those private lands (extensive agriculture and timber management), the number of roads and skid roads needed to support those activities, and the extensive mileage of roads that closely follow stream channels.

Acidity (pH)

The Pennsylvania age surface bedrock is typically low in calcium carbonate minerals that make it low in acid buffering capacity. These portions of the watershed characteristically have acid-forming rock and acid soils, which make streams slightly too strongly acidic. Mississippian age surface bedrock is substantially higher in minerals which contribute to stream alkalinity, although some streams may still be slightly to moderately acidic, or may be subject to acidification on an event basis (storm runoff or snowmelt events).

Temperature

Stream shading is critical in maintaining or reducing water temperature. Recently adopted riparian guidelines ensure stream shading by imposing no timber harvesting within 100 feet along each side of perennial and large intermittent streams, 50 feet along each side of small intermittent streams, and 25 feet along each side and above ephemeral stream channels. Planting of trees/shrubs suitable for riparian conditions may be recommended in areas where there currently is no stream shading.

Aquatic Resources

Information available for the preparation of this report includes: stream surveys conducted in 1988, 1991 and 2002; other planning reports on file at the Monongahela National Forest Supervisor's Office, Elkins, WV; fish sampling data from the West Virginia Division of Natural Resources (WVDNR), Elkins, WV; water quality data from the West Virginia Department of Environmental Protection (WVDEP) web site; and geographical information system (GIS) data layers on file at the MNF Supervisor's Office. Characterizations of habitat conditions for streams off-Forest are based on digital ortho photos in the GIS database, water quality data from the WVDEP, fisheries information from the WVDNR and from observations made during field reconnaissance trips in 2002 and 2003 to review various parts of the watershed.

Fish

Due to past management activities on public and private land, as well as recent flood events, streams across the forest have become deeply incised. Much of the material making up the substrate has been washed downstream and in many areas bedrock makes up a majority of the stream bottom. The Forest Plan standards and guidelines for all MP 6.1 include construction of stream improvement structures whenever possible to improve the pool/riffle ratio and create more stream cover and improve fish habitat.

Riparian

An essential aspect of managing aquatic resources is the protection of riparian areas adjacent to stream channels. Riparian areas provide a number of functions for the maintenance of fish habitat including stream shading, bank stability, and a source of large woody debris (LWD) and smaller organic inputs.

Vegetation

Approximately 2,200 species of vascular plants, growing without cultivation, are located in the State of West Virginia (Strausbaugh and Core 1977). The Monongahela National Forest is slightly larger than ten percent of the total area of West Virginia, but contains over 75 percent of the vascular plant species found in the State (Clarkson, Duppstadt, and Guthrie 1980). More than 20 commercial tree species and over 30 non-commercial trees and shrubs can be found in the Upper Tygart Valley Watershed.

Threatened/Endangered/Sensitive Flora

Running buffalo clover *Trifolium stoloniferum*, a S2/G3 state and globally ranked endangered plant occurs within the Upper Tygart Valley watershed. The definition of this rating of the species is: S2 – imperiled within the state because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extirpation within the state; G3 – either very rare and local throughout its range or found

locally (even abundant at some of its locations) in a restricted range, or because of other factors making it vulnerable to extinction throughout its range - within 21 to 100 occurrences.

Other threatened or endangered plants known to occur on the MNF include:

- Shale barren rock cress – *Abrabis serotina*
- Small whorled pagonia – *Isotria medeoloides*
- Virginia spiraea – *Spiraea virginiana*

Plant species listed as sensitive on the Eastern Regional Forester list dated 6/2/2003 include:

- Fraser fir - *Abies fraseri*
- White monkshood - *Aconitum reclinatum*
- Arctic bentgrass - *Agrostis mertensii*
- Lillydale onion - *Allium oxyphilum*
- Spreading rockcress - *Arabis patens*
- Cooper's milkvetch - *Astragalus neglectus*
- Lance-leaf grapefern - *Botrychium lanceolatum v.angustisegmentum*
- Showy lady's slipper - *Cypripedium reginae*
- Tall larkspur - *Delphinium exaltatum*
- Shale Barren wild buckwheat - *Eriogonum allenii*
- Darlington's spurge - *Euphorbia purpurea*
- Box huckleberry - *Gaylussacia brachycera*
- Appalachian oak fern - *Gymnocarpium appalachianum*
- White alumroot - *Heuchera alba*
- Crested coralroot - *Hexalectris spicata*
- Long-stalked holly - *Ilex collina*
- Butternut - *Juglans cinerea*
- Thread rush - *Juncus filiformis*
- Highland rush - *Juncus trifidus*
- Turgid gay feather - *Liatris turgida*
- Large-flowered Barbara's buttons - *Marshallia grandiflora*
- Bog buckbean - *Menyanthes trifoliate*
- Smokehole bergamot - *Monarda fistulosa v. brevis*
- Canada Mountain rice grass - *Oryzopsis Canadensis*
- Canby's Mountain lover - *Pachistima canbyi*
- Yellow nailwort - *Paronychia virginica v. virginica*
- White Mountain Silverling - *Paronychia argyrocoma*
- Swamp lousewort - *Pedicularis lanceolata*
- Sword-leaved phlox - *Phlox buckleyi*
- Jacob's ladder - *Polemonium van-bruntiae*
- Tennessee pondweed - *Potamogeton tennesseensis*
- Rock skullcap - *Scutellaria saxatilis*
- Robust fire pink - *Silene virginica v. robusta*
- Ammon's tortula - *Syntrichia ammonsiana*

- Appalachian bristle fern - *Trichomanes boschianum*
- Kate's Mountain clover - *Trifolium virginicum*
- Nodding pogonia - *Triphora trianthophora*
- Appalachian blue violet - *Viola appalachiensis*
- Rock grape - *Vitis rupestris*
- Netted chain fern - *Woodwardia areolata*

Forest Type/Size/Density

Plant communities characteristic of this area include the following series or associations:

1) sugar maple
2) sugar maple-beech
3) beech
4) sugar maple-red oak
5) red oak
6) sugar maple-basswood (cove hardwoods)
7) red spruce
8) red spruce-hemlock
9) yellow birch

This watershed has been managed for over 100 years through commercial logging activities. Most of the logging completed at the turn of the century was done by railroad using the clearcut harvest method, resulting in the even age forest present today. Selection harvesting during the 1950s left stands of trees that were high graded (cutting the large, high quality trees while retaining the small and/or low quality trees). To correct the high grading, clearcutting was again used during the 1960s and early 70s on a much smaller, more regulated scale. Only 4.3 percent (725 acres) of National Forest System land in this watershed is less than 45 years old (representing three age classes). The Forest Plan allows for 7 ½ percent (or ½ percent per year) of National Forest System land to be regenerated every 15 years in the 6.1 MP. To have balanced age classes there should be 22 ½ percent (3,739 acres) in the three age classes from 0 to 45 years.

Red spruce continues to decline as fast growing hardwood species out compete this slower growing, shade tolerant tree. Concerns over the continuing decline of this species have been discussed in numerous research papers. To date there is no conclusive evidence of any single cause contributing to the decline. (DeHayes and Hawley 1992; Friedland, Hawley, and Gregory 1985).

General accounts of the forests of mountainous areas of WV dating from the latter part of the 19th century describe timber resources of the state in the early 1870s. Species noted were sugar maple, birch, ash, cherry, yellow poplar, red spruce.

By the mid-1920s all of the chestnut trees in the eastern portion of WV were dead or dying from chestnut blight. These trees have almost been completely eliminated from the forest of eastern North America but chestnut has managed to survive by repeatedly sprouting from the root systems of blight-killed trees. Today, these trees normally do not

grow larger than 6 to 8 inches in diameter or taller than 40 feet before the blight kills the stem causing the roots to resprout and repeat the growth/mortality process.

Agriculture/Openings

Numerous grassy openings exist on private lands for grazing and hay production. The Desired Future Condition (DFC) on National Forest System Land is to attain five percent of the area in grassy openings scattered throughout the watershed.

Wildlife

Approximately 542 species (68 mammals, 230 birds, 160 fish, 42 reptiles, and 42 amphibians) may utilize the Forest's diverse vegetative and stream habitats during their lives. Upper Tygart Valley watershed provides habitat for a number of these wildlife species. Common small mammal species that inhabit this area include: red, gray and fox squirrels; chipmunks; skunk; opossum; various species of bats; voles; shrews; mice; and rabbits. These species play important functional roles such as pollination, seed dispersal and linkages within the food web. Important game species within the watershed include whitetail deer, grouse, snowshoe hare, beaver, fox, raccoon and turkey. Black bear and bobcats are likely present in limited numbers. All the aforementioned species are considered habitat generalists, with the exception of some bat species. All the species listed, with the exception of snowshoe hare, can be found throughout West Virginia, the Monongahela National Forest and the Upper Tygart Valley watershed area. There are no specific unique habitats that can only be found within the Upper Tygart Valley watershed.

There are approximately 127 known cave entrances (Forest Service lands and private) within the watershed (Medville and Medville 1995). They generally follow Greenbrier limestone bands that run along both the watershed's eastern and western boundaries. Many caves have hydrologic features. Four caves (six entrances) house endangered bat species while sensitive cave invertebrates and other bat species use those and many of the other caves. The Forest Plan Amendment for Threatened and Endangered species specifies standards and guidelines specific to caves and habitats surrounding those caves used by Indiana bats and Virginia big-eared bats. The Forest Plan general standards and guidelines address caves found on Forest Service land. Numerous rockshelters are found within the watershed area. These geologic landforms are potential bat roosts, woodrat shelters, green salamander habitat, and swallow nesting sites. Some of these sites may also be cultural heritage sites protected by law.

Amphibians require water or moist environments and are associated more with substrates such as down wood or rocky areas than with specific vegetation types or stages. Amphibians transfer nutrients from aquatic to terrestrial environments, are prey for predators, and contribute major biomass in forest ecosystems. Amphibians expected to occur within the watershed include a variety of salamanders, toads, tree frogs and true frogs. Reptile distribution is also more closely associated with elevation, aspect, and

substrate than with vegetation. Reptiles are susceptible to ground barriers (board walks on trail areas), road construction, and human predation. Reptiles inhabiting the Upper Tygart Valley area include eastern box turtles, five-lined skink, timber rattlesnake, garter snakes and black rat snakes. Similar to mammals found in this area, the majority of amphibians and reptiles that occur within Upper Tygart Valley watershed are those expected to occur there. With the exception of the Cheat Mountain salamander habitat located along the eastern boundary of the watershed, this area does not contain any unique features not found elsewhere on the Monongahela National Forest.

Game birds found in the area include turkey, ruffed grouse and mourning dove. Waterfowl species are also present in limited numbers, mostly as individual pairs or during migration periods. Numerous non-game bird species also use the diverse vegetation found within the watershed. Neo-tropical migrants use the area along with other bird species that remain as year-round residents. The study of birds in WV extends back into the early 19th century. Bird populations vary in number and distribution over time as habitats change. In 1983 West Virginia Birds: Distribution and Ecology (Hall 1983) compiled all known information on bird distribution within the state. This watershed area provides important breeding, nesting and/or foraging habitat for a variety of raptors such as the Great horned owl, American kestrel, sharp-shinned and Coopers hawk, Red-tailed hawk and other birds of prey. Once again however, the Upper Tygart Valley watershed is not unique in providing needed habitat for the bird species mentioned.

Invertebrate species are critical components of many ecosystem functions. They aid in the breakdown of matter, nutrient cycling, maintaining soil structure, chemistry and productivity, wood decomposition, pathogenic effects on other organisms as well as control of disease-causing organisms. Invertebrates make excellent bio-indicators of soil, water and vegetation health and can be found throughout the Upper Tygart Valley area. Sensitive cave invertebrates can be found in the same limestone derived caves as many of the bat species. These cave invertebrates are unique to a few cave systems, making the Upper Tygart Valley watershed area important for their continued existence.

Brown, rainbow, and golden trout are annually stocked in the Upper Tygart Valley headwaters by the WVDNR. Native brook trout is also present within Upper Tygart Valley watershed streams. These fish provide recreational game fishing along reaches of the Upper Tygart Valley. Non-game fish and aquatic invertebrates inhabit streams within the watershed. Stream surveys and macro invertebrate information has been collected and stream restoration work has been completed within the Upper Tygart Valley watershed. More information on Upper Tygart Valley fisheries resources can be found within the watershed assessment under the *Aquatic Resources* section of Chapter 3.

Forest Plan 6.1 MP guidelines suggest four water sources/square mile. Available water is not a limiting resource within the watershed. The Tygart Valley River runs north to south approximately through the watershed's middle. The Shavers Fork River is to the east, outside of the watershed boundary, and runs parallel to Tygart Valley River. Numerous

streams traverse the watershed area and there are man-made waterholes and ponds located on National Forest System land along the watersheds eastern boundary.

Generally, permanent habitat fragmentation is not an issue in West Virginia. Permanent habitat fragmentation occurs when forested land is converted to another use such as roads, grassy openings, or construction of buildings for residences, offices, and other commercial uses where trees once covered the landscape. Over 75 percent of West Virginia is forested. The Monongahela National Forest is over 90 percent forested. Temporary habitat fragmentation occurs when forested land is harvested through regeneration cuts. The effects of this temporary habitat fragmentation are relatively short-lived. Timber harvesting restrictions on National Forest System Land that limit the amount of acres regenerated, the size of each cut, and distances between cuts, make it highly unlikely that any temporary fragmentation would be sufficient enough to cause adverse impacts to wildlife that require interior forest habitats.

There are no Forest Service grazing allotments within the watershed, however there are approximately 538 acres of maintained wildlife openings, reclaimed strip mines and other "open" areas. Forest Plan 6.1 MP standards and guidelines suggest five percent of the gross area should be in permanent openings. This includes roads, fields, openings on private lands and utility corridors. Based on watershed size, there could be approximately 4,253 acres of open land.

Threatened/Endangered/Sensitive (TES) Fauna

The Monongahela National Forest lists eleven threatened or endangered species, occurring within the Forest. However, both the gray wolf and eastern cougar are considered extirpated from WV. Five threatened/endangered species or their habitat can be found within the Upper Tygart Valley watershed area. These include West Virginia Northern Flying Squirrel, Indiana and Virginia big-eared bats, Cheat Mountain salamander and Running buffalo clover.

The 2000 Regional Forester Sensitive Species list (RFSS) for the Monongahela National Forest includes 46 fauna and 41 flora species. This list is designed to be dynamic and will change over time based on new information, inventory and monitoring. Appendix C contains the Likelihood of Occurrence table for the Upper Tygart Valley watershed. This table was designed to take a broad-based look at habitat within an area and compare that to existing species populations and habitats. The current GIS layer relative to threatened, endangered and sensitive species located four known sensitive plant species, two known sensitive fauna species and five endangered species within Forest Service boundaries.

Management Indicator and Emphasized Species

Management Indicator Species (MIS) were selected to represent important game species, threatened and endangered species, species of unique interest, and species that represent other habitats. The objectives were to maintain viable population levels for TES species, or to reach desired population objectives for other species. The Forest Plan contains a list

of MIS and associate species for monitoring management impacts on area fauna species and their habitats (See Forest Plan, Appendix L) that includes the Virginia big-eared bat, Indiana bat, Cheat Mountain salamander, wild (native brook) trout, black bear, wild turkey, white-tailed deer, gray squirrel, varying (snowshoe) hare and West Virginia northern flying squirrel. Appendix L in the Forest Plan also lists population objectives for each species. Each MIS species listed in Appendix L (Forest Plan), or their habitat known to occur within or border areas of the Upper Tygart Valley watershed.

Human Uses

Recreation

A semi-primitive non-motorized (SPNM) Recreation Opportunity Spectrum (ROS) setting is prescribed for this management area. Recreation developments are determined based on public health and safety, protecting the environment, complementing SPNM recreation opportunities, and meeting public demand.

The primary recreational activities occurring within this watershed analysis area are hunting, fishing and general dispersed recreation. Overall recreation use within the area is relatively low.

Minerals-Coal/Gas/Oil

Of the 16,617 acres of federally owned surface in this watershed, about 1,532 acres (10 percent) have reserved or outstanding minerals estates with the remainder (90 percent) of the acreage being a federally owned mineral estate. The predominant resource of coal in the Watershed area would come from the unmined portion of the Kanawha and New River Fm, which is found predominately along the western perimeter of the watershed area. Gas resources typically could be expected to come from two geologic formations in this region – the Oriskany Sandstone/Huntersville Chert and the Tuscarora Sandstone. Given the proper structural feature, these two formations could be expected to yield natural gas resources. There is no known oil potential in this watershed.

Mineral materials removal potential in this watershed is negligible and not expected to change in the foreseeable future. It consists of an occasional request for a personal use permit to remove a few tons of native stone from the land surface.

Heritage Resources

This area is rich in upland resources that would have made it attractive to prehistoric peoples. These resources include numerous sources of fresh water, land and riparian transportation routes (including the Seneca Trail), access to lithic materials, game, and a wide variety of flora. Some rockshelters are present that may have provided excellent long- or short-term encampment locations.

Given the current state of research in the watershed area, it is not possible to characterize in any meaningful way prehistoric use of landscape on National Forest System land. This inability is due to the fact that very few site evaluations have been conducted. Thus, while some sites have been identified, we do not know when they were occupied or what types of activities their inhabitants were engaged in. The previously recorded rockshelters may have a very high potential for yielding important information on prehistoric utilization of the area. Until these sites and potentially important open-air sites are evaluated, our knowledge of the prehistory of the project area will remain unknown.

It is known that the area has a high potential for locating prehistoric resources based on the results of previous surveys. At least ten previously recorded prehistoric villages and/or burial mounds have been located in the assessment area, mainly in the area of Huttonsville. The high density of prehistoric sites can be attributed to the location of the project area adjacent too well-known prehistoric travel routes, the Seneca Trail and the Tygart River Valley. The Tygart Valley is also an area of very high agricultural potential. In addition, the project area contains significant outcroppings of Greenbrier limestone, a potential source of high-quality lithic raw material.

Historic Euro-American use of the landscape was focused primarily on farming, logging and mining; activities that started in the mid- to late 18th century. These activities were centered at the town of Beverly. Logging boomed around the turn of the 20th century, but withered after about 1920. Historic logging and mining activities have significantly impacted the landscape. In particular, early logging practices caused significant soil erosion and loss. However, the forest has regenerated significantly under the stewardship of the Forest Service since the 1920s.

Special Uses

Occasionally, there is a need for private property owners or businesses to access their land through National Forest System land. Special use permits are negotiated and written to allow some of these uses on National Forest System Lands. Other uses, such as utility right-of-way corridors are also permitted. All special use permittees must meet the same environmental standards as those applied to Forest Service facilities.

Roads/Trails

The existing road system is not adequate to access all areas of the National Forest System that have active MPs. In addition, some existing roads from previous land use activities are no longer needed. A long range transportation plan needs to be developed to determine future access needs and which existing roads should be abandoned, obliterated, or used for some other purpose such as linear wildlife openings or trails.

Trail management objectives emphasize non-motorized activities and densities should range between 0 - 1 mile/ square mile. Travel-ways will normally be closed to public

vehicle use. Selected areas may be opened to motorized use for specific activities such as hunter distribution and firewood cutting during specific timeframes.

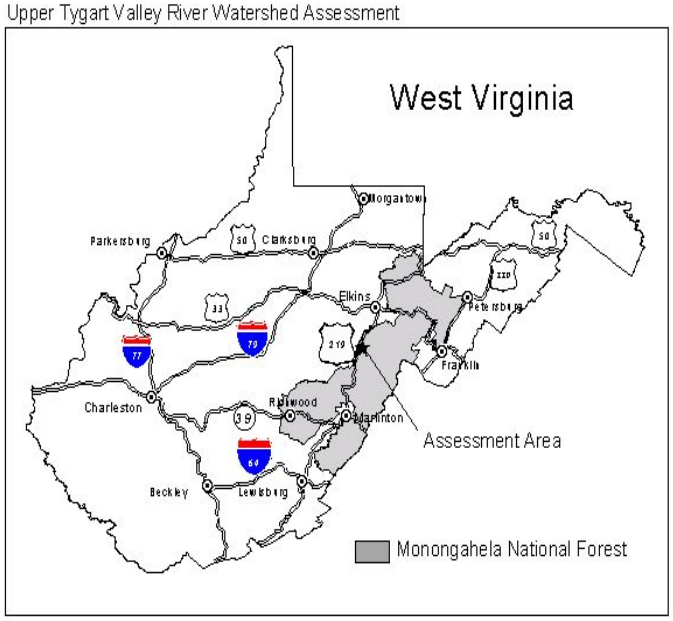
Landlines

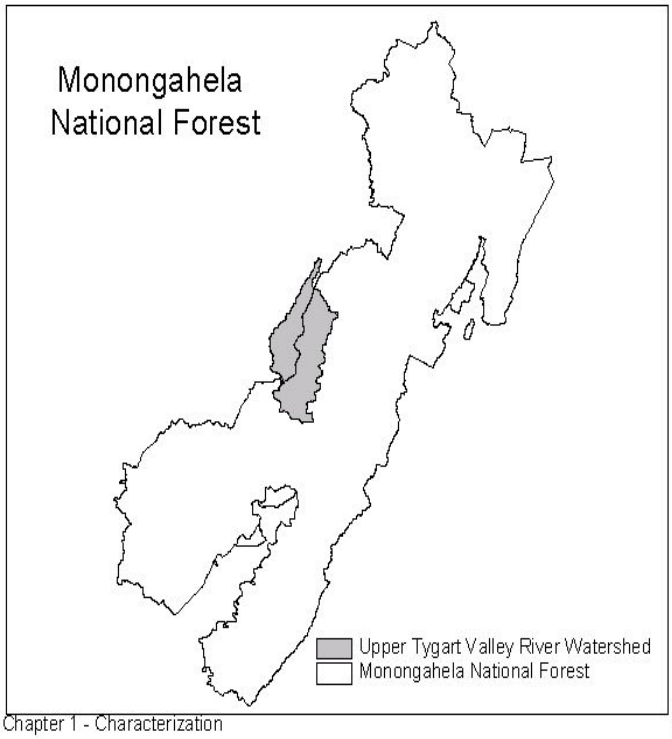
Landlines are the property boundaries that delineate National Forest Lands from private lands. Location and maintenance of property boundaries, using standardized survey methods, have not kept pace with deterioration. Occasionally, occupancy or timber harvest trespass occurs due to the difficulty of locating these lines on the ground. The Forest Plan specified that all landlines should be surveyed and marked to standard by the year 2020. The current Forest Plan guidelines (p.96) suggest landlines be maintained every 10 years.

Private Land

Several small communities are located within the Upper Tygart Valley watershed including Mingo, Valley Head, Huttonsville, Monterville, and Mill Creek. Agricultural fields for grazing and crops are located mostly in and adjacent to the Upper Tygart Valley River floodplain, gently sloping sidehills, and broad ridgetops.

Upper Tygart Valley River Watershed Assessment

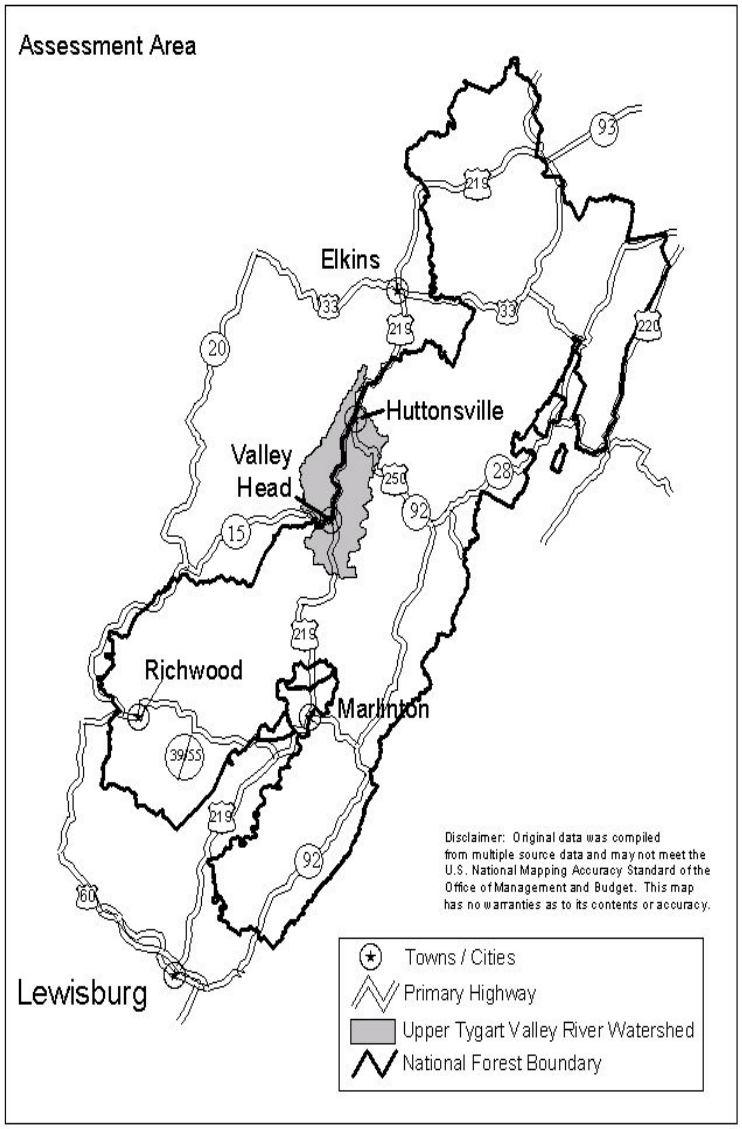




Monongahela NF

Upper Tygart Valley River Watershed
#050200010100
Vicinity Map

Chapter 1
Map 1-1



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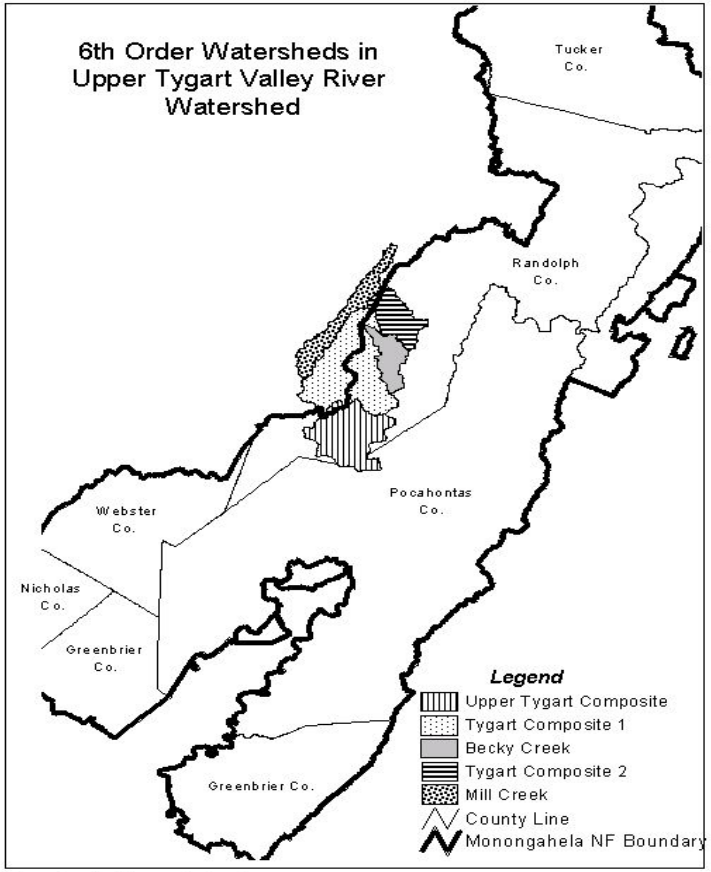
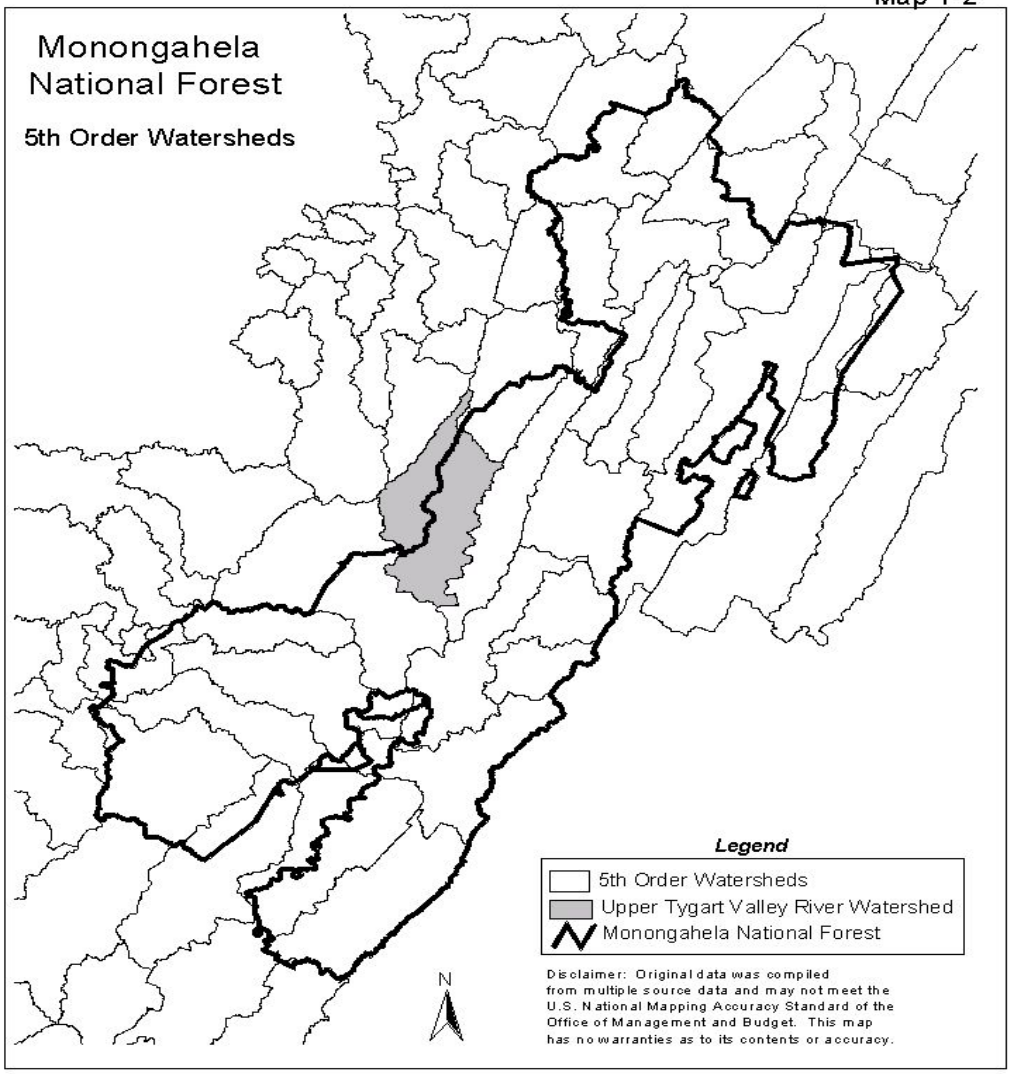
Upper Tygart Valley River Watershed Assessment

Chapter 1
Map 1-2

Monongahela NF
Upper Tygart Valley River Watershed
#050200010100
5th and 6th Order Watershed





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Chapter 1 - Characterization

Chapter 2 – Issues

Issue Identification Process

The development of high priority issues is important to focus the scope of a watershed assessment. Key questions that address the issues further refine the assessment.

This chapter covers current high priority issues and key questions identified within the Upper Tygart Valley watershed by internal review of the area. The issues and key questions are organized by core topics.

Erosion Processes

Erosion and sediment production caused by erosion leads to water quality and aquatic issues/concerns. Concerns relating to the Region 9 Interim Soil Quality Standards do exist; however, the extent of the concerns is not known.

- What erosion processes are dominant within the watershed?
- Where have they occurred or where are they likely to occur?
- To what extent has soil quality diminished due to historic activities?
- Can soil quality best be improved through active or passive management?

Air Quality

Acid deposition is believed to have an unquantified effect on the soil resource in the Upper Tygart Valley watershed. It is theorized that those effects are dependent upon underlying geologies, management practices, elevation, and local depositional rates.

- Does acid deposition have the potential to affect soil nutrient status through acidification?
- Which forest management activities would have a long term positive or negative effect on soil acidification?

Hydrology/Stream Channels

Road construction and maintenance and turn-of-the-century logging have reduced channel complexity through the addition of sediment and reduction of large wood falling into stream channels. Past management activities on public and private land, as well as recent flood events, have resulted in deeply incised stream channels across the forest. Much of the material making up the substrate has been washed downstream and in many areas bedrock makes up a majority of the stream bottoms.

- What opportunities exist to increase the amount of LWD in streams?

- What opportunities exist to decrease the amount of sediment in streams?
- Are there opportunities to restore floodplains and meanders in streams?
- What are causes of current, unstable hydrologic processes within the watershed?
- What are the dominant hydrologic characteristics (total discharge, peak flows, minimum flows) and other notable hydrologic features and processes in the watershed (cold water seeps, groundwater re-charge areas)?

Water Quality

Road construction and maintenance, old woods roads, lack of or failure of erosion control structures on closed temporary roads and skid roads, illegal All-Terrain Vehicle (ATV) use, and acid deposition are contributing to water quality degradation.

- Which water quality parameters are critical?
- What is the current water quality and are there problem areas?
- How is water quality being affected by land uses and acid deposition?

Aquatic Resources

The Upper Tygart Valley watershed provides important habitat to fish and aquatic invertebrates. Riparian habitat is a critical component needed by many wildlife species. Timber harvest activities around the turn of the century affected riparian areas throughout the watershed by cutting and removing most of the trees along streams. Today most stream systems still lack sufficient levels of large wood debris to provide quality fish habitat.

- What beneficial uses dependent on aquatic resources occur in the watershed?
- What could be done to improve riparian and fish habitat conditions?
- Are current riparian conditions affecting stream shading and water temperatures?
- What activities might occur that could reduce riparian habitat conditions and the potential for recruitment of LWD and fish habitat improvement?
- How are the current riparian conditions contributing to existing channel conditions?

Vegetation

Management activities such as timber harvest, road building, mining, and the introduction of non-native diseases, insects, and plants may have changed species composition or altered the biological diversity of the watershed.

- What is the array and landscape pattern of plant communities and seral stages in the watershed?
- How does the current condition compare with the historic range of variability?
- What processes caused these patterns (fire, wind, soil erosion, insects, diseases, timber harvesting, agriculture)?
- How does the current condition affect future land management objectives?

- Have botany surveys been completed? Have any TES plants been found in the watershed?
- What effect does recent past and current management activities on private land have on future management plans on National Forest System Land?
- Are there opportunities to balance age classes, reduce stocking density, and improve forest health through active management activities?

Wildlife

Management activities such as timber harvest, road building, agriculture, and the introduction of non-native species may have affected wildlife species habitat in the watershed.

- How fragmented is the Upper Tygart Valley watershed, in terms of percent open land and percent forested land?
- Is the area too fragmented for some species but not fragmented enough for other species?
- What is the relative abundance and distribution of TES species, featured species, management indicator species, or other species of concern and their habitat?
- Will certain types of management or no management have a negative or a positive effect on TES species and/or their habitat?
- Are there opportunities to improve the habitat for TES or other species?
- Is there a conflict between timber harvest goals and habitat requirements, TES or other species that occur within the watershed?
- Would certain types of timber harvesting improve some habitat needs that are presently lacking?
- Are we meeting the population objectives for management indicator species? Are the population objectives for game species appropriate?
- Are we meeting recovery plan objectives and monitoring requirements for TES species?
- Are current riparian areas in suitable condition to support riparian species?
- Are human recreation pressures having negative effects on TES/wildlife species and their habitats?

Human Uses

The use of the watershed for mining, recreation, timber harvest, mineral production, and associated roads and trails contributes to the economic health of local communities. Multiple use resource management activities may conflict with single use objectives. Approximately 17 percent of the Upper Tygart Valley watershed is in NFS land, 12 percent in state owned land, and 71 percent in private land holdings. Characterization of the uses and impacts on state owned and private land will help in the determination of cumulative effects in future analyses.

- What are the major human uses of this watershed? Where do these uses occur in the watershed?
- Have heritage resources surveys been completed to locate prehistoric and historic cultural sites?
- Where are prehistoric sites likely to occur in the watershed?
- How does the distribution of different kinds of sites (i.e., sites containing different kinds of functional and temporal information) vary?
- How do site locations correspond with anticipated patterns of disturbance (e.g., from projects, development, public use/access, or natural processes)?
- What are the locational characteristics of sites with significance to contemporary Native Americans?
- Where these kinds of sites are likely located within the watershed and what condition are they in?
- What kinds of features will make the greatest contribution to our knowledge about the nature/condition of past ecosystems, and associated land-use histories?
- What types of sites would be likely to contain these types of features?
- In what locations/settings would these types of sites have the greatest likelihood of preserved features?
- Is illegal ATV traffic on NFS land in this watershed causing irreparable harm to other resources?
- Are Scenic Management System (SMS) goals and objectives being met for management activities on NFS land?
- Are dispersed recreation sites in desirable settings or causing damage to other resources?
- What management actions are occurring on private lands in the watershed?
- Are any near future management activities planned on state owned lands?

Chapter 3 – Reference and Current Conditions

Erosion Processes

Ecologic Land Types

M221Ba Northern High Allegheny Subsection

M221Ba01 - CHEAT-SHAVER'S-BACK ALLEGHENY MOUNTAIN SYSTEM

LTA Ba01 is comprised of approximately 8,476 acres of the land area of the Upper Tygart River watershed. The distinguishing feature of the Cheat-Shaver's-Back Allegheny Mountain System is the moist climate (52 inches of annual precipitation), dissected plateau, elevations above 4,000 feet, red spruce habitat, and some rare elements. Landforms consist of dissected plateaus. The geology is made up of Pennsylvanian era sandstone, shale (Kanawha and New River formations) and some coal deposits. The primary erosion process is surface erosion. Elevations range from 4,000 to 4,800 feet. Soils have a primarily frigid soil temperature regime; however, there are some pockets of warmer climatic conditions that result in soils having a mesic temperature regime.

Soil families include the 1) Mandy-Trussel-Gauley (frigid soils) series and 2) Dekalb-Buchanan series (mesic soils). Drainage density patterns are high but are less than in the Southern High Allegheny Subsection. Vegetation associations are comprised of the red spruce, red spruce-eastern hemlock, yellow birch, and sugar maple-beech communities. Management implications in this LTA include habitat for the northern flying squirrel and the Cheat Mountain salamander. This LTA is not suitable for prescribed burning.

M221Ba02 CHEAT MOUNTAIN SLOPES

LTA Ba02 is comprised of about 8,220 acres of land area of the Upper Tygart River watershed. The distinguishing features of the Cheat Mountain Slopes are the productive mixed mesophytic sites and the Mauch Chunk geologic formation. Landforms consist of steep side slopes of Cheat, Shaver's, and Back Allegheny Mountains. Elevation ranges from 3,000 to 4,000 feet. The geology is comprised of the Mauch Chunk formation of Mississippian age: red and green shales. The primary erosion process is surface erosion. On the steep slopes of this LTA, soils high in clay content tend to be unstable, and landslides are common. Landslide deposits may underlay much of the landscape resulting in large acres of colluvial soils on sideslopes and ancient colluvial deposits tens of feet thick in toeslope positions. This LTA has only one soil family-- Cateache-Shouns-Belmont. Vegetation associations are comprised of red oak, red oak-sugar maple, and sugar maple-basswood. Aquatic systems and types are dendritic, steep, and high energy. Drainage density patterns--relatively low, but regular pattern in hollows. Management implications for this LTA are 1) high soil fertility - very productive sites but

susceptible to surface erosion if disturbed; 2) high herbaceous diversity; 3) high forest songbird abundance and diversity; and 4) moderate value for bats.

M221Ba03 UPPER TYGART VALLEY

LTA Ba03 is comprised of 30,639 acres of the land area of the Upper Tygart Valley River watershed. The distinguishing feature of the Upper Tygart Valley is the foothills west of Cheat Mountain. The annual precipitation is 45 inches. The geology is Devonian age, Chemung and Brallier formations. The primary erosion process is surface erosion. Elevations range from 2500 to 3500 feet. Surficial geology consists of sandstone and shale-clast loamy colluvium which is poorly stratified. Fragments of sandstone, conglomeratic sandstone, and shale make up the colluvial material. On the steep slopes of this LTA, clays tend to be unstable, and landslides are common. Landslide deposits may underlie much of the landscape. Landforms consist of foothills with steep slopes and greatly varying aspects. Soil families are Berks-Weikert. Drainage density patterns are fairly high following regular pattern in the hollows. Vegetation series are: red oak, white oak, chestnut oak-red maple, red oak-sugar maple, and pitch pine on southern aspects at lower elevations. Management implications in this LTA include vegetation patterns that are strongly affected by aspect, and the lower elevations on average are drier. This LTA is generally suitable for prescribed burning.

M221Ba04 TYGART VALLEY RIVER RIPARIAN

LTA Ba04 is comprised of 4,398 acres of the land area of the Upper Tygart Valley River watershed. The distinguishing features of the Tygart Valley River Riparian are the alluvial deposits, wide spread agricultural use of the land, and the riparian vegetation. The annual precipitation is 45 inches. The geology is Quaternary alluvium. The primary geomorphic process is alluvial deposition. Elevation is 2000 feet. Surficial geology consists of alluvial sandy gravel of Holocene and Late Wisconsin age which is poorly stratified and ranges in thickness from three to ten meters. Landforms consist of floodplains and terraces. The primary soil association is the Monongahela soil type. Drainage density patterns are fairly high following regular patterns in the hollows. Vegetation series are sycamore and slippery elm. Management implications in this LTA include most land use is agricultural and some urbanization, and there is no National Forest System ownership.

M221Bc – Southern High Allegheny Subsection

M221Bc01 – Allegheny Plateau LTA

LTA Bc01 is comprised of 8 acres or less than 1 percent of the land area of the Upper Tygart Valley River watershed. The distinguishing feature of the Allegheny Plateau is the vast area with highly dissected topography, northern hardwoods and mixed mesophytic, productive sites. Landforms consist of broad ridges with steep (20 to 60 percent slopes) hill and mountain sideslopes. The geology is made up of Pennsylvanian sandstone/siltstone/shales and includes a portion of the red shales from Mauch Chunk

Formation in the eastern portion of the watershed. Primary erosion processes include surface erosion (sheet, rill, and gully) and landslides. Landslides are estimated to underlie 21 to 50 percent of the landscape. The landslides have occurred over geologic time frames and are formed of colluvial soil material. Soils that exist over the Mauch Chunk formation are highly erodible and are prone to mass movement. Soils are primarily moderately deep (20 inches to 40 inches) to very deep (greater than 60 inches.) Very deep colluvium may exist on some footslopes that may be up to 25 meters deep. Soil Families include: Gilpin – Buchanan, Cateache-Shouns-Belmont. Annual precipitation is approximately 45 inches. The soil temperature regime is mesic. Plant communities are sugar maple, beech, sugar maple-beech, red oak, sugar maple-basswood, sugar maple – red oak, cherry, and tulip poplar are prevalent as well in this LTA.

M221Bc03 CLOVERLICK SYSTEM

LTA Bc03 is comprised of 8,916 acres of the Upper Tygart Valley River watershed. The distinguishing feature of the Cloverlick System is the steep, broad-ridged mountains. This LTA is the transition area from Northern to Southern High Allegheny Subsection. There are some limestone areas in the LTA. Landforms consist of broad ridges with steep (20 to 60 percent slopes) hill and mountain sideslopes. Elevation ranges from 3,000 to 4,000 feet. The geology is made up of Pennsylvanian sandstone/siltstone/shales and some Greenbrier limestone. The primary erosion process is surface erosion. Soil Families include: Gilpin – Dekalb – Buchanan and Cateache-Shouns-Belmont. Annual precipitation is approximately 45 inches. The soil temperature regime is mesic. Plant communities are beech, sugar maple-beech, red oak, sugar maple-basswood, and sugar maple – red oak. Management Implications for this LTA include limestone areas that are generally in pasture; hence this LTA is relatively fragmented. Sites at lower elevation are generally suitable for prescribed burning.

Soils

Berks-Weikert – Strongly sloping to very steep, well drained, acid soils on uplands.

This soil association consists of rounded hills at the foot of higher, very steep hills and narrow ridges. This association is adjacent to terraces and flood plains of the Tygart River Valley. Bedrock is exposed at the surface in some areas, especially those areas that are greater than 50 percent slope. Slopes range from 15 to 70 percent.

The Berks soils are moderately deep. They formed in material weathered from interbedded shale, siltstone, and fine-grained sandstone. Berks soil has a very dark grayish brown, channery, medium textured surface layer and a yellowish brown, channery, medium textured subsoil.

The Weikert soils are shallow (10 to 20 inches). They formed in material weathered mainly from shale and siltstone. Weikert soils have a dark brown, shaley medium-textured surface layer and brown, very shaley, medium textured subsoil.

Some areas near the Tygart Valley River bottoms are farmed and used for grazing. Major management concerns are wind-throw on Weikert soils, severe erosion potential from trails and roads, and shallow depths of bedrock which restrict root development and excavation.

Monongahela - Nearly level to gently sloping (three to eight percent) terrace soils formed from alluvial material along the Upper Tygart Valley River.

The Monongahela soils are deep, moderately well drained, nearly level to strongly sloping (three to eight percent slope), and found on terraces along the Upper Tygart Valley River system. This soil type formed in alluvial material washed from soils on uplands. These soils are primarily used for agricultural purposes and are designated as prime farmland. Some urbanization has occurred on these soil types in the valley. There is some hazard of flooding in low lying areas.

Mandy-Gauley-Trussel – Dominantly frigid soils formed in material derived from level-bedded sandstone, siltstone, and shale.

Mandy and Gauley soil series are strongly sloping (4 to 16 percent) to very steep (> 45 percent slopes), moderately deep and very deep, well drained and moderately well drained loamy soils that formed in sandstone, siltstone, and shale on mountainous uplands and foot slopes.

Trussel soils are gently sloping to strongly sloping (3 to 15 percent), very deep, poorly drained soils that formed in colluvial material derived from sandstone, siltstone, and shale. The landscape is characterized by rough, rugged mountainous topography. It is a greatly dissected, high plateau that has broad, gently sloping (1 to 8 percent slopes) ridgetops and knobs and very steep (> 45 percent slopes) side slopes. This soil family is found generally at elevations of more than 4,000 feet. Sandstone outcrops, stones, and boulders on the surface are common. The native vegetation is dominantly red spruce, red maple, yellow birch, and American beech. The Trussel soils have hydric soil properties and are often associated with wetland vegetation. These soils are on foot slopes, coves, drainage ways, and benches of the landscape. They formed in colluvium derived from shale, siltstone, and sandstone.

The Gauley soils are on broad ridgetops under dense stands of red spruce. They formed in material weathered from sandstone. They have a black, coarse textured surface layer and dark reddish brown and strong brown, medium textured subsoil.

The minor soils in this map unit are the well drained Simoda series to the east. To the south in Pocahontas County minor soils may include the Briery series and Udorthents in disturbed areas, the somewhat poorly drained Leatherbark soils on broad ridgetops, the very poorly drained Medihemists in depressions on broad flats, and the well drained to poorly drained Udifluvents and Fluvaquents on flood plains.

The majority of this soils family is within the Monongahela National Forest. About 95 percent of the unit is wooded and used for timber production, recreational activities, or wildlife habitat. This soils family extends south well beyond the southern boundary of the Upper Tygart Valley Watershed. Red spruce is the dominant species on the ridgetops, knobs, and the upper side slopes that have west aspects. It is used by rustic fence industries in Pocahontas County, Randolph County, and the surrounding area. Hardwoods are in the more protected areas of the unit. The main limitations of these soils for most uses are the slope, the stones on the surface, the depth to bedrock, and a seasonal high water table.

Cateache-Shouns-Belmont – Soils derived from level-bedded sandstone, siltstone, shale, limestone, or chert.

Gently sloping (1 to 8 percent slopes) to very steep (> 45 percent slopes), moderately deep, very deep, and deep, well drained loamy soils formed in siltstone, limestone, shale, and some sandstone; on mountainous uplands and foot slopes The landscape is characterized by broad, strongly sloping (4 to 16 percent) ridgetops; very steep side (> 45 percent slopes) slopes broken by long, narrow, moderately steep (10 to 30 percent slopes) benches; and gently sloping (1 to 8 percent slopes) to steep (20 to 60 percent slopes) foot slopes. Drainageways have cut into the side slopes forming very steep (> 45 percent slopes) coves. Stones and boulders are common in this unit. Sandstone and limestone outcrops are in bands across some of the slopes. The native vegetation is dominantly a northern hardwood forest.

The Cateache soils are moderately deep and well drained. These gently sloping (1 to 8 percent slopes) to very steep (> 45 percent slopes) soils are on ridgetops and side slopes. They formed in material weathered from dark reddish brown siltstone, shale, and fine-grained sandstone. They have a very dark brown, medium textured surface layer and dark reddish brown and reddish brown, medium textured subsoil.

The Shouns soils are very deep and well drained. The gently sloping (1 to 8 percent slopes) to very steep (> 45 percent slopes) soils are on foot slopes and benches and in coves. They formed in colluvial or alluvial material derived from sandstone, siltstone, shale, and limestone. They have a very dark grayish brown, medium textured surface layer and brown, reddish brown and dark reddish brown, and medium textured subsoil.

The Belmont soils are deep and well drained. These gently sloping (1 to 8 percent slopes) to very steep (> 45 percent slopes) soils are on benches and side slopes. They formed in material weathered mainly from limestone with some interbedding of sandstone, siltstone, and shale. They have a very dark grayish brown; medium textured surface layer and dark yellowish brown and dark brown, medium textured subsoil.

Most of this land use in this soils family is timber production, recreation, and wildlife habitat. Sugar maple, American beech, black cherry, northern red oak, and a few red spruce are on the upper two-thirds of the landscape, and black locust, black walnut, and shagbark hickory are on the lower third of the landscape. Cleared areas of the unit

generally follow the limestone geology. Most of the cleared areas are used for pasture with the less sloping areas being used for the production of winter feed. A few limestone quarries are in the unit. The main limitations of these soils for most uses are the slope, the stones on the surface, and downslope soil movement.

Gilpin – Dekalb – Buchanan – Strongly sloping (15 to 35 percent slopes) to very steep (>50 percent slopes), well drained and moderately well drained, acid soil; on mountainous uplands and foot slopes.

This association mainly consists of broad ridgetops, steep and very steep hillsides, and strongly sloping and moderately steep foot slopes. Narrow flood plains cover a part of the association. Stones cover the surface of much of the acreage, and there is some exposed bedrock.

Gilpin soils are moderately deep, well drained, and strongly sloping (15 to 35 percent slopes) to very steep (> 45 percent) slopes. These stony soils are on uplands. They formed in acid material weathered from interbedded shale, siltstone, and sandstone. They have a dark brown; medium textured surface layer and yellowish brown, medium textured subsoil.

Buchanan soils are very deep, moderately well drained, and moderately steep (10 to 30 percent) slopes to very steep (> 45 percent) slopes. These soils are on foot slopes. These soils formed in colluvial, acid material that moved downslope from areas on uplands. They have a very dark grayish; moderately coarse textured surface layer and a yellowish brown, medium textured subsoil that is mottled in the lower part.

Dekalb soils are moderately deep, well drained, strongly sloping to very steep, and are on uplands. The soils formed in material weathered from sandstone and some interbedded siltstone and shale. Dekalb soils have a very dark brown to brown, channery, medium textured surface layer and a yellowish brown, channery, moderately coarse textured subsoil. Management concerns include moderate to severe erosion hazard, slope limitations, depth to bedrock, a season high water table in Buchanan soils, moderately slow and slow permeability in Buchanan soils, and minor flooding hazards in narrow flood plains.

Gilpin–Buchanan – Strongly sloping (15 to 35 percent slopes) to very steep (>50 percent slopes), well drained and moderately well drained, acid soil; on mountainous uplands and foot slopes.

This association mainly consists of broad ridgetops, steep and very steep hillsides, and strongly sloping and moderately steep foot slopes. Narrow flood plains cover a part of the association. Stones cover the surface of much of the acreage, and there is some exposed bedrock.

Gilpin soils are moderately deep, well drained, and strongly sloping (15 to 35 percent slopes) to very steep (> 45 percent) slopes. These stony soils are on uplands. They

formed in acid material weathered from interbedded shale, siltstone, and sandstone. They have a dark brown; medium textured surface layer; and yellowish brown, medium textured subsoil.

Buchanan soils are very deep, moderately well drained, and moderately steep (10 to 30 percent) slopes to very steep (> 45 percent) slopes. These soils are on foot slopes. These soils formed in colluvial, acid material that moved downslope from areas on uplands. They have a very dark grayish; moderately coarse textured surface layer and a yellowish brown, medium textured subsoil that is mottled in the lower part. Management concerns include moderate to severe erosion hazard, slope limitations, depth to bedrock, a season high water table in Buchanan soils, moderately slow and slow permeability in Buchanan soils, and minor flooding hazards in narrow flood plains.

Dekalb–Buchanan – Strongly sloping (15 to 35 percent slopes) to very steep (>50 percent slopes), well drained and moderately well drained, acid soil; on mountainous uplands and foot slopes.

This association mainly consists of broad ridgetops, steep and very steep hillsides, and strongly sloping and moderately steep foot slopes. Narrow flood plains cover a part of the association. Stones cover the surface of much of the acreage, and there is some exposed bedrock.

Dekalb soils are moderately deep, well drained, strongly sloping to very steep, and are on uplands. The soils formed in material weathered from sandstone and some interbedded siltstone and shale. Dekalb soils have a very dark brown to brown, channery, medium textured surface layer and a yellowish brown, channery, moderately coarse textured subsoil. Management concerns include moderate to severe erosion hazard, slope limitations, depth to bedrock, a season high water table in Buchanan soils, moderately slow and slow permeability in Buchanan soils, and minor flooding hazards in narrow flood plains.

Buchanan soils are very deep, moderately well drained, and moderately steep (10 to 30 percent) slopes to very steep (> 45 percent) slopes. These soils are on foot slopes. These soils formed in colluvial, acid material that moved downslope from areas on uplands. They have a very dark grayish; moderately coarse textured surface layer and a yellowish brown, medium textured subsoil that is mottled in the lower part.

Some soils in the Upper Tygart Valley River watershed are sensitive for: flooding (hydric soil designation is often used in wetland delineations); slippage; steep slopes (30 to 70 percent); wetness (moderately well drained or wetter); and limestone parent materials.
The Forest Plan provides guidance for activities that include the use of wheeled and /or tracked motorized equipment on steep and very steep slopes (Forest Plan Appendix S page S-4). Slopes 40 to 50 percent allow the operation of this type of equipment on a case by case basis to determine the best method of operation and the risks associated. Slopes 50 percent or greater prohibit equipment use on all soil types unless the site is

analyzed by an interdisciplinary team and the activities receive Forest Supervisor approval. To calculate acreages of slopes 50 percent or greater, 30m Digital Elevation Model software was used. There are approximately 727 acres of National Forest System lands in the Upper Tygart Valley Watershed that have slopes 50 percent or greater. It is recommended that all activities that require ground disturbance or add to slope instability be avoided in these areas. Associated risks on these soil types and very steep slopes are high.

Table 3.1-Total acreages for each sensitivity group on National Forest System lands.

SENSITIVITY GROUP	ACRES
Slopes greater than or equal to 50%	727
Slippage	603
Slippage and Steepness (30 to 70 % slope)	1128
Flood	1
Flood-Hydric	10
Flood-Wet	239
Limestone	918
Limestone and Steepness (30 to 70 % slopes)	605
Wet	1037
TOTAL	5268

The desired future condition of the soil resource would be to meet the Region 9 Interim Soil Quality Standards. The standards that pertain to the Upper Tygart Valley watershed are issued for soil productivity levels, compaction, soil fertility, and disturbance.

Geology

Pennsylvanian - Pottsville Gp

The Kanawha Fm is described as interbedded sandstone and shale with a general thickness of 500 - 675 feet. This formation is generally described as containing massive gray coarse – conglomeritic sandstones, dark and sandy shales, and coals.

The New River Fm is also described as interbedded sandstone and shale with a general thickness of 250 - 400 feet. It also contains mineable coal.

Mississippian - Mauch Chunk Group

The Bluestone Fm is predominantly a red or green shale with some thin green sandstone interbedded and can vary in thickness from 100 - 300 feet. (Reger, 1931 pg 286)

The Princeton Fm is characterized as a green - gray coarse-grained sandstone which grades to a conglomerate composed of large white quartz pebbles. The Princeton, in the area, is massive and makes conspicuous ledge. (Reger, 1931 pg 288)

The Hinton Fm is predominantly a shale member with some sandstone and limestone interbedded and varies in thickness from 200 - 400 feet. (Reger, 1931 pg 289)

The Bluefield Formation is a red-green shale which grades into a red-green sandstone varying in thickness 300 – 650 feet. (Reger, 1931 pg 296)

The Greenbrier Group is a distinctive sequence of bedded limestone varying in thickness from 100 – 400 feet throughout Randolph County. (Reger, 1931 pg 316)

The Maccrady Formation is a mixed sequence of limestone and shales with a known maximum thickness of 50 feet. Its only appearance in Randolph County is within this watershed area. (Reger, 1931 pg 336)

The Pocono Group varies in thickness from 25 – 225 feet. It is composed almost entirely of interbedded red-gray-brown sandstones and shales. (Reger, 1931 pg 340)

Devonian

The Hampshire Formation comprises a large portion of the exposed surface rock in the watershed area. It is mixture of red-green shales and red-green sandstones varying in thickness from 600 to 1200 feet. (Reger, 1931 pg 352)

The Chemung Group comprises a large portion of exposed surface rocks in the watershed area. It is a mixture of olive-green shales and olive-green sandstones varying in thickness from 2500 – 3000 feet. The Chemung makes extensive outcrops throughout Randolph County. (Reger, 1931 pg 361)

The Brallier Formation is composed of very thinly bedded green-gray flagstones and green-gray shales. It varies in thickness from 2000 – 2500 feet. Usually very wrinkled or folded in outcrop. (Reger, 1931 pg 382)

Table 3.2 – Upper Tygart Valley Geologic Column

Upper Tygarts Valley Generalized Geologic Column						
Period or System	**Series**		**Map Symbol**	**Thick. Feet**	**Total Feet**	**Description**
Recent			Qal	?	?	Unconsolidated Clays and Gravels. (River Wash)
Lower Carboniferous Pennsylvanian	Pottsville Group	Kanawha Fm	Ck	500 - 675	675	Gray massive conglomeratic sandstones at top; gray massive coarse sandstones below, dark and sandy shales; coals; occasional thin zones of marine fossils, abundant plant fossils.
		New River Fm	Cnr	250 - 400	1075	Gray massive coarse sandstones in upper and middle portions; heavy conglomerate sandstones at base; dark or sandy shales; several good coals; thin zones of fresh or brackish water fossils, abundant plant fossils.
Lower Carboniferous Mississippian	Mauch Chunk Group (Cmc)	Bluestone Fm	Cbl	100 - 300	1375	Mostly red or green shales with thin lenses of red or green micaceous flaggy sandstones.
		Princeton Fm	Cpr	15 - 50	1425	Green or gray sandstone, often coarse and conglomeritic with occasional plant fossils.
		Hinton Fm	Chn	200 - 400	1825	Mostly red or green shale with red or green sandstones; heavy sandstone at base; thin streaks of coal; occasional marine fossils; a few plant fossils.
		Bluefield Fm	Cbf	300 - 650	2475	Red or green shales; red or green sandstones occasionally coarse and gray; dark or calcareous shales and limestones towards base with abundant marine fossils; a few plant fossils; coal streaks.
	Greenbrier Group		Cgr	200 - 400	2875	Dark siliceous limestone at top followed by gray oolite and zones of red shale and sandstone; gray siliceous oolite near middle; dark amorphous limestones in lower part with streaks of red shale; abundant marine fossils; a few plant fossils
	Maccrady Fm		Cmcc	0 - 50	2825	Red or purple shale with sandy streaks.
	Pocono Group		Cpo	50 - 225	3050	Mostly gray or brown sandstone with thin gray or dark sandy shales; abundant marine fossils; also plant fossils.
Devonian	Hampshire Fm		Dck	600 - 1200	4250	Red or green shales; redish-brown or greenish-brown, micaceous and cross bedded sandstone; fish remains and bivalves near top; rather abundant plant remains, including ferns (Archaeopteris and Dimeripteris) and stems of trees.
	Chemung Group		Dch	2500 - 3000	7250	Greenish-gray conglomeritic sandstone (Hendricks) at top followed below by olive-green shales and olive-green or greenish-brown flagstones, zone of greenish-brown or reddish-brown sandstone (Valley Head) about 400 feet below top of series, followed below
	Brallier Fm		Db	2000 - 2500	9750	Greenish-gray flagstones and greenish-gray, or dark sandy shales alternating throughout series; a very few marine fossils, numerous small stems or branches of trees in middle or lower part and occasional large stems.

Air Quality

Air quality is locally monitored on the Monongahela National Forest on the Fernow Experimental Station. The Monongahela National Forest is primarily affected by air masses from the west and southwest, although weather does come from the southeast often in times of tropical airflows and hurricanes. Most of the air masses derive from the Ohio River Valley and are transported to central West Virginia. Upon meeting the Allegheny Mountains, the air masses rise and cool whereupon precipitation falls, orographic uplifting.

Annual rainfall in the Upper Tygart Valley watershed is approximately 45 inches per year ranging up to 52 inches in the higher elevations. Rainfall pH values have been monitored at the Fernow Experimental Forest and average pH of 4.2 (Adams, et. al., 1994). Rainfall without acid contaminants generally has a pH of about 5.7 (Morrison, 1984).

Air quality has been the subject of research and monitoring at the Fernow Experimental Forest for a number of years (Adams et. al., 1994). Monitoring of air quality for the Fernow has been conducted on the Nursery Bottom, located approximately two air miles from the Fernow boundary, on the Fernow itself, and at locations more distant: Clover Run (8 miles northwest of the Fernow), and Bearden Knob (approximately 13 miles east of the Fernow).

Acid deposition has been the most intensively studied of the major air pollutants on the Fernow Experiment Station. Formed by the burning of fossil fuels, sulfur dioxide and nitrogen oxides can transform into weak acids in the atmosphere and return to earth as acidic deposition in the form of rain, fog, cloud and dry particles. There are relatively few industrial sources locally, although emission from automobiles and trucks can contribute significant amounts of nitrogen. Most of the pollutants that are deposited on the Monongahela National Forest come from the west, usually the Ohio River Valley industrial complex.

The Timber and Watershed Laboratory of the Fernow Experimental Forest participates in the National Atmospheric Deposition Program (NADP), a nation-wide precipitation chemistry-monitoring program. The results of this program demonstrate that some of the highest levels of nitrogen and sulfur found in the eastern U.S. are deposited on the Fernow Experimental Forest via wet deposition. Deposition in bulk precipitation is approximately 10 to 14 lb/N/ac/yr and 12 to 15 lb/S/ac/yr (1998). Dry deposition is estimated to be approximately the same as wet deposition. The greatest deposition occurs during the growing season (Gilliam and Adams, 1996.) Recently deposition has been changing in Tucker County. Sulfate deposition at the Nursery Bottom has declined by almost 33 percent since 1989 (NAPAP, 1998.), and this change is attributed to the 1990 Clean Air Act Amendments. Nitrogen deposition trends are not as clear, but appear to be increasing. Deposition of basic elements (Ca, Mg) has decreased since the late 1970's as fly ash and particulate emissions have decreased (NADP/NTTN data; adp.sws.uiuc.edu).

The relationship between air quality and soil nutrient status is complex. Research has developed many models to help predict the effects of acid deposition on soils. Predicted effects include decreasing soil ph, loss of macronutrients in soils, and mobilization of heavy metals. Continued research in the 1990s documents distinct decreases in soil calcium over the past 4 to 5 years in both the Northeast (Johnson et. al., 1994a) and Southeast (Richter et. al., 1994.) where acid deposition has been perceived to be a concern. These decreases were attributed primarily to the uptake of calcium by trees in excess of inputs from weathering. As forests mature, soils naturally acidify due to the uptake and storage of nutrients by the above ground biomass. The vegetation stores more and more of the nutrients in the above ground biomass as time goes on, and only upon death and decomposition of that biomass are those nutrients returned to the soil to be utilized by new growth and organisms. In addition, researchers and land managers also know that both acid deposition (Markewitz et. al., 1998) and a decline in atmospheric deposition of calcium may have also contributed to the decrease in the availability of soil calcium in the East (Johnson et. al., 1994b.) Several studies have suggested that forest harvesting could also reduce calcium availability through the removal of calcium stored in trees, which could lower the growth rates of the regenerating stand (Federer et. al., 1989; Hornbeck et. al., 1990.) Relationships among acid deposition, calcium/nutrient availability, forest productivity, and soil productivity remain uncertain because of many of the unknowns about the relationships of input and outputs of soil calcium/nutrients and roles that other soil properties play in nutrient cycling and soil productivity (USGS, 1999; Grigal, 2000.)

Timber harvesting is known to remove nutrients from soils, however it cannot be said with certainty that the amount of soil nutrient removal associated even with very intensive harvests, including whole tree removals, would deplete soil nutrient levels to an extent such that regrowth would be impaired. Although some research would suggest that soil nutrient depletion should occur following biomass removals (Federer et.al, 1989; Hornbeck et.al, 1990; Weetman and Weber, 1972; Boyle et. al., 1973, Silkworth and Grigal, 1982; Federer et.al, 1989), follow-up research has not shown that to be the case (Knoepp and Swank, 1997; Johnson et al., 1997; Johnson and Todd, 1998). Although frequently hypothesized, nutrient deficiencies as a result of over story removal have not been reported in eastern hardwood forests (Adams, 1999). The literature has suggested that less intense harvests would be mitigation to potential soil nutrient depletion concerns (Adams et al., 2000). The types of harvests analyzed by researchers are often worst-case scenarios of removal of total biomass, such as whole tree harvesting (Federer et al., 1989). Timber harvesting on the Monongahela National Forest does not allow whole tree (total biomass) removal. Additional factors of traditional harvest practices on National Forest System Land would serve to ameliorate potential effects of soil nutrient depletion.

Acid deposition is believed to have an unquantified effect on the soil resource in the Upper Tygart Valley watershed. It is theorized that those effects are dependent upon underlying geologies, management practices, elevation, and local depositional rates. It is believed that the Pottsville geology is the most sensitive to the effects of acid deposition due to the lack of alkalinity in the geology. (However, the Pottsville geology is not uniform across the forest. It is known that this group is stratified with interbedded shales

that do have a source of calcium and magnesium in them upon weathering. This is more true as the geology runs south and west.) There are approximately 5,755 acres of the Kanawha Formation of the Pottsville Group. Most of this formation falls outside of National Forest System land in this watershed. However, there are small acreages along the eastern boundary.

Hydrology/Stream Channels

Reference Condition

Reference conditions within the Upper Tygart Valley Watershed are difficult to determine, since most of the area has been substantially impacted by past activities, and to some extent present day land use. The dominant land use that has affected how streams and watersheds look today is the turn of the century logging and access development. Recent land management activities, on private lands in particular, are likely having substantial watershed impacts. Most of the watershed is private land where activities include agriculture, grazing, timber management and strip mining. A small amount of strip mining has also occurred on National Forest System Lands, but the amount of watershed disturbance has been relatively small. The present day transportation system, and older access roads and trails, also contribute to changed watershed conditions. Acid deposition is having an impact on soil and stream chemistry. These activities act to modify watershed processes, and riparian and aquatic conditions from their past, or reference conditions.

Morphology

Stream channel morphology in the late 1800's, before the extensive timber harvesting occurred, are likely to be substantially different than the channel shape and condition of today. In general, channels would have exhibited more stable forms, with narrower width and more quality habitat features. There would have been considerably more LWD in the channels, contributing to long-term channel stability, habitat quality and complexity. Channel profiles would have been more stable, with greater channel roughness to dissipate energy. Non-perennial headwater channels, and small perennial channels would have exhibited more of a step-pool profile. Less channel incision would exist, and floodplain function would have been improved. Channels would have been better "connected" to their floodplains, and floodplains would have performed their natural function of storing floodwaters more efficiently than in some present day locations. This would reduce flood energy within the channels, reducing the amount of bank erosion and instability. Overall, channels would tend to be narrower, and base flows deeper.

Flow Rates

Reference conditions of streamflow would also be somewhat different than flows, as they exist today. The primary factors that control those differences today are the amount of present day roads, skid roads, old woods roads and railroad grades, compaction, historic and present day timber harvesting, and surface mining. Streamflow would have been

somewhat less flashy in the reference condition, because there would have been less channel extension from the present and old transportation network, and less compaction from a variety of land uses. It is likely that base flows and low flows would have been somewhat greater than the present day condition, because the effective drainage density (length of channel per unit area) would have been less, and soil infiltration would have been greater.

Mining, especially on private lands, has been occurring over the last 50 years or so. Surface mining has left land in a cleared condition for an extended period of time. The reference condition would have been a nearly intact forest throughout nearly all of the areas that have been mined. Mined lands likely yield more water to streamflow in the growing season, because evapotranspiration losses are less in the cleared land condition. In the reference condition, evapotranspiration losses would have been greater, so streamflow in those sub-watersheds may have been slightly less during the growing season. The amount of this effect would have been relatively small. However, greater infiltration and soil storage would have existed in the reference condition, because roads and compaction from mining would have been absent. So to some extent, there would have been offsetting factors in those areas where roads and grassy openings from mining now exist.

Timber harvesting, as we know it today, would not have existed in the reference condition. Although the native inhabitants cut trees for firewood and lodging they most likely took longer periods of time to harvest the trees. Intensive timber harvesting in the east has been found to increase the annual water yield from the harvested area, with the majority of those increases occurring in the growing season and mostly as increased base flows and low flows. But those water yield increases are relatively small and short term, with streamflow returning to pre-harvest levels usually within three to ten years (Hornbeck and Kochenderfer 2000). In the reference condition, streamflow would have been unaffected by timber harvesting (due to the length of time it would take to cut enough trees over a large enough area with primitive stone tools), so yield increases most likely would not have occurred. The truck and skid road transportation systems and old railroad grades did not exist, so precipitation would have infiltrated and been detained more efficiently.

Overall, streamflow in the reference condition was very likely to have been somewhat more evenly distributed and not as flashy. Soil moisture storage was greater and release to the stream channels was slower. Base flows were likely greater than the current condition, as well as low flows. But the magnitude of this difference is difficult to predict. Greater base flows and especially low flows under the reference condition, combined with narrower channels and more LWD, would have maintained better quality habitat in the streams.

Storm Flows

Storm flows in the reference condition would have been unaffected by the land uses that came later. Land uses thought to have the greatest influence are the existing

transportation system, old roads with inadequate drainage, lands cleared by mining, and timber harvesting. By far the great majority of mining and recent timber harvesting has occurred on the private lands. In general, storm flows would have slightly to moderately less volume in the reference condition because of the undisturbed nature of the sub-watersheds. Storm runoff would have been less concentrated and slower, with a greater percentage of the precipitation being detained in the soil for slower release. The greatest difference between the current and reference conditions would likely have been for the smaller to moderate sized storm events. Also, floodplain function would have been improved in the reference condition, and a greater proportion of flood flows would have occupied the floodplain, reducing the erosive energy within the stream channels.

On National Forest System Lands, storm peak flows in the reference condition may not have been substantially different, compared to the current condition, for the major, flood-producing storms, particularly during the dormant season when most floods occur. Overall, smaller storm flows or longer storm flow duration, and greater floodplain storage in the reference condition would have meant less erosive energy within the stream channels. In general, stream channels would have been more stable, with less channel bank erosion and sediment deposition within the channel. Aquatic habitat would have been higher quality because of the greater bank stability, less sediment deposition, lower fine sediment, and other habitat features.

Current Condition

Morphology

Streams have developed in response to the soils/geologic/topographic and vegetation conditions within the watershed, precipitation characteristics, and past and present land uses that occur. Streams exhibit a combination of stable and unstable forms, which reflect the influence of natural stream processes and the effects of certain land uses within the sub-watersheds. Channel bank erosion occurs on some portions of all channels. There are sections of channel deposition, as well. Some of this is a natural process, and part of the “dynamic equilibrium” nature of streams. However, the effects of roads and other land uses, riparian clearing, and within channel modifications such as loss of LWD may contribute to channel changes from more stable to less stable forms.

The morphology of streams within the assessment area has been affected to some extent by the past and present land uses. Some channel bank erosion is part of the natural stream process, and some is likely to be the result of a combination of land use effects, particularly early 1900’s timber harvesting in the watershed, mining, and transportation system developments.

Floods occur frequently in the Upper Tygart Valley watershed and are a substantial impact in terms of upland soil erosion, stream and river channel erosion, sediment/bedload transport, and deposition within the channel system. Therefore, floods play a major role in channel morphology and stability, and much of this effect is natural.

But some flood related channel instability and morphology change can be made worse when the channel is in an unstable condition to start with. Flood "recovery" or repair activities can frequently exacerbate problems in stream channels; such as in road related flood recovery work, by deepening or widening channels, and depositing berms of river rock and gravel along the stream bank. These natural and human-caused processes are working in the Tygart Valley River system. The section on storm flow discusses floods in more detail.

The morphological effects of these changed conditions is that in some cases stream channels may become more entrenched, reducing the ability of the floodplain to store water during times of flood. In some other channel reaches sediment deposition occurs, and channel widening can result. Accelerated channel erosion increases bedload and deposition downstream, and is an increased source of fine sediment to fish-bearing streams. Sometimes split channels can develop when high bedload and channel widening is a problem. These processes are affecting portions of the channels within the assessment area.

Flow Rates

Streamflow within the various subwatersheds tends to be highly variable, dependent on seasonal and precipitation characteristics, and possibly the influence of land management activities within the watershed. Such seasonal variability is influenced by precipitation patterns, and by water loss due to evapotranspiration during the vegetative growing season. Snowmelt in the late winter and spring contributes substantially to higher stream flows. As mentioned, streamflow tends to be not only variable, but flashy, responding quickly to the influence of topography and soils, soil moisture conditions at the time of precipitation, rainfall amounts and intensity, and land uses.

On National Forest System Lands, very little long-term clearing of lands has occurred, except for roads. Long-term changes in streamflow associated with conversion of forest to some other land use are not expected. Changes in streamflow from timber harvesting can be substantial, but are of relatively short duration (from five to ten years or less). Most of the streamflow change due to timber harvesting occurs in the growing season and primarily causes a temporary increase of low flows and base flows through reduced evapotranspiration losses. Changes in flow rates depend on the size, intensity, harvest method, and location of cutting. At least 20 percent of the basal area within a watershed must be removed within one year to cause any measurable change in flow rate (Patric 1984). The total acres harvested within a watershed are what contribute to these flow rate changes, not unharvested areas downstream.

Runoff rates are also affected by compaction or reduced infiltration within the watershed, such as in a limited amount of grazing land, on highways, roads and skid roads, mined lands and other uses that substantially disturb and compact soils. U.S. Highways 219 and 250 and State Highway 15 are major linear disturbances that have modified and compacted soils, intercepted subsurface water, and increased runoff rates particularly during storm runoff. Also, roads and other facilities that intercept surface water and

shallow groundwater have the effect of concentrating and speeding flow away from the upper portions of the watershed (leaving less water available for soil storage and floodplain recharge). This likely is having the effect of increasing flows during storm runoff and snowmelt situations, but also reducing base flows and low flows, as well. Thus, flows are re-distributed to a less even flow condition. The magnitude of this effect is not well known, but could be substantial in some localized portions of the sub-watersheds, and within the watershed as a whole. The most pronounced flow effects would occur in those sub-watersheds with the most intensive development and management. On National Forest System Lands, some of these changed flow conditions may also occur, but would be on a much smaller scale and more dispersed throughout the watershed.

Private land development and disturbance within the watershed is likely to be affecting stream flows to a much greater extent than conditions within the National Forest. The towns of Mingo, Valley Head, Huttonsville, and Mill Creek (as well as other municipal/domestic and industrial development and roads along the river corridor) are having streamflow effects by reducing infiltration and floodplain recharge, and speeding concentrated runoff. Private land timber harvesting is having these same effects, mostly in the large private landholdings west of the Tygart Valley River.

These changes in flow conditions are likely having an effect on the morphology of the upper non-perennial streams, and to some extent the downstream perennial streams as well. Altered flows also increase the fine sediment supply to aquatic habitats, and during low flows the available aquatic habitat is reduced, putting an even greater stress on aquatic biota.

Storm Flows

Streams are flashy in their response to larger storms, especially the more intense storms. Flow tends to rise rapidly under those conditions, and will fall rapidly as well, returning to base flow conditions rather quickly. Major frontal weather systems and tropical storms from the south or east can carry substantial quantities of rainfall. Other major storm events are fairly frequent, and generally occur during the dormant season of the year (November through mid-May), when evapotranspiration losses are minimal. This further adds to rapid storm runoff.

Past and recent floods are a substantial impact within this watershed as a whole, in terms of upland soil erosion, stream and river channel erosion, and sediment/bedload transport and deposition within the channel system. Floods are naturally occurring factors within streams and rivers, especially in the mountains, and they play an important role in channel sediment relationships, sediment flushing, creating and distributing habitat, floodplain development, etc. In managed but predominantly well-forested watersheds, floods, especially large floods, are controlled primarily by the characteristics of the storm events themselves. For the major flood events in this part of West Virginia, the over-riding factor of significance in valley flooding is the magnitude and intensity of the storm, and other topographic factors like soil depth and slope steepness. Forested land

use conditions have less effect on downstream flooding for major flood events, because the size and timing of the precipitation event dominates the flood characteristic. More drastically disturbed or intensively managed lands with greater compaction, extensive and poorly-located road systems, and inadequate surface runoff control measures can substantially add to storm flow and sometimes peak flows, especially during the growing season and for the more routine storm runoff events.

Certain land uses that reduce the soil infiltration and water holding capacity, and reduce riparian vegetation, contribute to increased storm flow and storm flow effects on stream channels. Road development can act to extend the channel system within the watershed, concentrating flows and speeding runoff to downstream areas. Ground-based timber harvest activities can have some of these effects as well, through skid-road development. Extensive watershed harvesting of timber can sometimes alter the hydrology and storm flow characteristics of the watershed. Grazing and agriculture frequently have detrimental effects on streams through soil compaction and reduced infiltration, and loss of healthy riparian vegetation. Mining drastically disturbs the land, and alters watershed hydrology and storm flow characteristics. Municipal development that occupies floodplains and riparian areas, eliminates streamside vegetation, drastically compacts the soil or paves over it, causing reduced infiltration and increasing surface runoff by concentrating storm runoff from roads and ditch lines.

Normal forest management practices in the eastern United States generally have a small to modest effect on storm flow volume, but a less clear effect on storm peak flows (Reinhart et al, 1963; Kochenderfer et al, 1997; Edwards and Wood, 1994; Hornbeck, 1973; Hornbeck, 1997; Hewlett and Helvey, 1970). Studies where an entire small watershed area (less than 100 acres or so) was harvested (in some cases herbicides were used after logging to keep the watershed from revegetating) documented storm flow increases. These documented effects were only for the treated watersheds, not for downstream areas. Storm flow increases were almost always of relatively short duration, usually only five to ten years or less (depending on the harvest treatment), and most of the increase occurred during the growing season, not during the dormant season. Removal of all the vegetation within a watershed rarely (if ever) occurs on managed National Forest System Lands. Storm flow effects related to normal, recent National Forest System management practices within any given sub-watershed would not be great because most of the sub-watershed areas are primarily forested, and a relatively small amount of harvesting has taken place over the last 25 years on National Forest System Land. The developed road system on National Forest System Land in this watershed is also much less dense than on private land.

Other types of activities and land uses are likely to produce different storm flow effects. Activities that change the land use for a longer period of time would likely extend the duration of a storm flow effect, particularly if compaction or runoff concentration occurred. Roads and highways that concentrate flows and reduce soil water storage would speed storm flow runoff, and increase storm flow volume (and peak flows as well under some situations). Those effects could persist for the long term. U.S. Highways 219 and 250 and State Highway 15 are likely having these effects in the main stem of the

Tygart Valley River. Also, from Huttonsville downriver, there are likely some storm flow and peak flow effects of the town and other municipal developments occupying the floodplain and lower slopes, with the substantially reduced infiltration that occurs there.

These types of storm flow effects are occurring within the Upper Tygart Valley watershed. Storm flow increases would tend to destabilize channels, increase channel bank erosion, increase deposition of sediment in some reaches of the channels, and increase fine sediment over the long-term. Over the short-term, higher storm flows can flush fine sediment out of the smaller, higher gradient streams.

According to our database, there are approximately 355 miles of stream with the Upper Tygart Valley 151 sq. mile watershed. The drainage density works out to be 2.35 mi/sq. mi. The Natural Resources Conservation Service has approved the construction of a considerably sized impoundment on the west side of the watershed. This should not affect Forest Service management activities as there are no National Forest System lands above or near the impoundment location. The table below gives the distance, elevation change, and area drained of most of the major perennial streams in this watershed. There are numerous unnamed perennial and intermittent streams within the watershed that are not mentioned here.

Table 3.3 - List of major streams in the Upper Tygart Valley watershed.

Stream	Reach	Area (Square Miles)	Distance (Miles)	Total Elevation Change (feet)	Rate of Change (feet/mile)
Tygart Valley River	Source to mouth	1,435.0	130.2	3130	24.04
Tygart Valley River	Source to Valley Head		9.3	1620	174.19
Tygart Valley River	Valley Head to Mill Creek		16.7	405	24.25
Mill Creek	Source to mouth	18.08	14.0	1610	115.0
Mill Creek	Source to Potatohole Fork		3.0	395	131.67
Mill Creek	Potatohole Fork to mouth of Right Fork		11.0	1215	110.45
Riffle Creek	Head of McGee Run	11.05	6.5	1550	238.46
Becky Creek	Source to mouth	14.55	8.7	1600	183.91
Elkwater Fork	Source to mouth	13.64	7.1	1090	153.52
Elkwater Fork	Source to Stony Run	1.98	3.4	830	244.11
Elkwater Fork	Stony Run to mouth		3.7	260	70.27
Big Run	Source to mouth	4.12	4.6	1225	266.3
Conley Run	Source to mouth	5.0	3.8	1300	342.11
Hamilton Run	Source to mouth	4.19	2.8	600	214.29
Logan Run	Source to mouth	2.64	2.8	1120	400.0
Ralston Run	Source to mouth	8.07	5.8	1050	181.03
Stewart Run	Source to mouth	10.82	7.2	1840	255.55
Windy Run	Source to mouth	6.85	4.7	1470	312.77

Water Quality

Reference Condition

Reference conditions within the Tygart Valley River can only be speculated upon, since all the sub-watersheds, and the streams that drain them, have been substantially impacted by past and present day land use. Reference conditions for water quality would have reflected the relatively undisturbed condition of the sub-watersheds. Essentially none of the present day human-caused conditions (such as roads and conventional timber harvesting) that affect water quality in these sub-watersheds would have existed under reference conditions.

Sediment

Sediment conditions in streams would have been controlled mostly by natural processes, and not influenced by the variety of land clearing and disturbance activities that exist today. Natural processes would have included all of the types of erosion that occur today (sheet, rill, gully, slides, stream bank, etc), but in different proportions and amounts. Riparian areas would have been largely intact (except for locations of native villages and subsistence agriculture) leading to improved channel stability. Overall, bedload sediment and fine sediment are likely to have been at moderately to substantially lower levels, and suspended sediment during storm flow conditions would have also been lower. Aquatic habitats in the tributaries of the Upper Tygart Valley watershed would have exhibited a higher quality because of the reduced sediment conditions. The aquatic community in general would benefit, and trout reproduction would have been maintained at a higher level.

Acidity (pH)

Stream acidity under reference conditions would have been governed by the natural buffering capacity of the soils and bedrock, and by the natural acidity of precipitation and the influence of vegetation. In general, the pH of most streams was probably slightly to moderately higher, although the magnitude of this effect is not known. In the reference condition, acid deposition, as we know it, did not exist (although precipitation was still acidic). Acid shock events from summer storms and snowmelt runoff were not a problem. Streams within the watershed were better buffered and maintained a higher pH, despite their natural tendency to be acidic and low in fertility, because of the soil/geology characteristics described earlier. The aquatic community would have been healthier under those reference conditions.

Temperature

Stream temperatures under the reference condition would likely have remained lower during summer low flows within the tributaries and main stem Tygart Valley River. This would be due to the combined effect of a more intact riparian forest, generally narrower

channel width in some stream reaches, and maintaining greater base flows. Lower summer stream temperatures would have benefited the native aquatic community.

Current Condition

Sediment

Like many streams across the Monongahela National Forest, channels within the Upper Tygart Valley watershed have a deficiency of LWD and associated cover. Stewart Run was surveyed in 1989-1990 and LWD occurrence was generally less than one piece of wood per 100 feet of stream. In addition, this watershed likely does not meet the MP 6.1 guidelines for pool habitat. Pool habitat in Stewart Run made up only 5-10 percent of the stream area. This watershed also likely continues to have elevated silt and fine sediment levels ranging from 15-20 percent. Historic records and stream habitat surveys indicate that portions of Stewart Run contain fine sediment levels that are below the threshold for sustaining native brook trout populations. However, other portions are at or near threshold levels. In 1989, high levels of fine sediment were noted in the lower reaches of Stewart Run on private land. In 1995, fine sediment levels in trout spawning gravels in the upper reaches of Stewart Run were estimated to be 15-20 percent. The lower reaches of Stewart have fine sediment levels in spawning gravels in excess of 20 percent. Spawning gravel samples collected from Windy Run in 2002 had fine sediment levels of 23 percent. This level of fine sediment can be detrimental to trout productivity.

Acidity (pH)

Water samples were taken from several streams within the Upper Tygart Valley Watershed in November 1990. The samples were tested for conductivity, alkalinity, acidity, turbidity, pH and temperature. Stewart Run was sampled in April 1991. The following table shows the data obtained from the samples.

Table 3.4 - Water Quality Information

Stream	Date	Temp °F	Sp. Cond. umhos/cm	pH	Alkalinity mg/l	Acidity mg/l	Turbidity NTU
Riffle Creek	11/28/90	44	90	7.85	28.0	2.0	0.9
Becky Creek	11/28/90	44	84	7.80	24.5	2.0	1.1
Conley Run	11/28/90	44	110	8.25	415	1.0	1.0
Windy Run	11/28/90	44	134	8.25	57.0	1.0	1.4
Big Run	11/28/90	44	96	8.05	37.5	1.5	1.0
Stewart Run	04/09/91	46	76	7.5	20.5	2.0	1.9

These samples indicated that water quality in these streams was good to excellent. They all have chemistry characteristics that are very suitable for fish and other aquatic organisms. Specific conductivity is a measure of the water's ability to conduct an electric current. Generally, the higher the conductivity rating, the more likely the water is well buffered from acid deposition.

Temperature

Some streams on private lands may have impaired habitat quality from increased water temperature, but no temperature data was collected for this assessment. Part of this effect is related to reduced quality of riparian habitats (riparian clearing for timber harvesting and roads along stream channels), and it also is related to increased sediment loads in streams. As deposition occurs, aquatic habitats become simplified and channels may widen and become shallower. Wider, shallower stream channels are more susceptible to temperature increases during the critical summer and early fall months when low streamflow occurs together with higher daytime temperatures and more intense solar radiation. The streams most likely to be impaired are the Tygart Valley River main stem, and portions of those sub-watersheds where extensive road development has occurred.

Aquatic Resources

Forest Plan guidelines for MP 6.1 state that 30-50 percent of a stream's area should be maintained as pool habitat and that cover along a stream should make up 30 percent of the stream area. Trees in riparian areas should be managed so that canopy closure is maintained at 75-100 percent along perennial trout streams less than 25 feet wide. This canopy closure helps maintain stream temperatures appropriate for trout. The Forest Plan directs the initiation of projects to rehabilitate human and natural sources of erosion when silt levels exceed a level of 15 percent in stream substrate.

Reference Condition

No reference, or undisturbed, watershed conditions exist within the Upper Tygart Valley River drainage in which to compare and contrast the existing conditions to. Without that baseline, we have to speculate how conditions might have been prior to the changes that have occurred with its development. Significant modifications have been made with the settlement of the watershed, the growth of agricultural activities, and the landscape scale clear cutting that occurred at the turn of the last century.

Fish

Native brook trout were probably in greater abundance although pressure from native inhabitants may have had an effect on the fish population. Sensitive non-game species may also have been in greater abundance.

Riparian Habitat

Prior to the logging that occurred in the late 19th and early 20th century, spruce was more prevalent in the watershed and streams flowed through densely forested riparian areas (except in the wider floodplains where native villages or subsistence agriculture may have been located). The LWD that would fall into the stream channels from these

riparian forests were probably more mature and larger diameter than the stands comprising the riparian areas today. Larger trees fallen in the stream channel are generally more stable (not easily moved by flood waters) and last longer (do not decay as rapidly) than smaller diameter trees. We can also speculate that spruce was a greater component of LWD, at the higher elevations, than what we see today and conifers generally decompose slower in streams than hardwoods. With the natural recruitment of LWD, channels were more stable, had greater habitat complexity, pool development and cover. There were probably more reach types characterized as step pool and/or pool-riffle than the dominance of plane bed reaches under current conditions. With no roads to modify storm flows and increase erosion, stream channels would be more stable and have lower levels of fine sediment than what we find today. LWD structure within ephemeral and intermittent channels increased channel roughness, which would dissipate stream energy and store sediment, nutrients, organic matter and moisture within the watershed. Stream shading in forested riparian areas result in cooler water temperatures.

Erosion in an undisturbed watershed would be less due to the lack of roads and other ground disturbing activities. Fine sediment levels within the stream channels in turn would likely be lower than what we observe today.

Current Condition

Fish

Fisheries resources can be characterized by the physical, chemical and biological components that make up the aquatic ecosystems in the Upper Tygart Valley watershed. Physical attributes are natural factors such as the geology, topography, precipitation, soil and vegetation characteristics that influence the channel shapes, stream flow patterns and water qualities that govern fish populations within the watershed. These natural characteristics are in turn affected by land management activities that can alter the natural characteristics of the soil, water, air and vegetation in the watershed. The combination of natural variation and management activities shape the quality of aquatic habitat within the watershed and affect the biological potential of the streams. Discussions of the geology, soil, water and vegetation characteristics can be found in greater detail in other sections of this assessment.

Another natural factor, flooding, is currently influencing the fisheries resources in the watershed. Flooding in recent years has affected stream channel characteristics and most likely fish populations. The watershed is subject to intense storm fronts that result in flashy flows within the smaller tributaries that feed the larger streams. Management activities can also influence runoff patterns by compacting soils and reducing the rate that water can soak into the watershed. As a result of recent floods, stream channels within the Upper Tygart Valley watershed show evidence of scouring, bank cutting and bedload deposition that have altered channel characteristics and fish habitat. Immediately following floods, fish populations are often reduced due to the displacement of fish downstream. However, depending upon the severity and timing of the flood, fish populations can quickly rebound as if rejuvenated by the floods.

Current fish habitat conditions in the Upper Tygart Valley River watershed are largely influenced by the history of land management activities within the watershed and the current ownership patterns. The majority of fish-bearing streams, including most of the Tygart Valley River main stem and its major tributaries, occur on private and state lands. The one exception to this is Stewart Run where a significant portion of the main stem and tributaries are on NFS lands.

Modification of habitats off-Forest has occurred with residential and agricultural developments, roads, logging, and in parts of the Mill Creek subwatershed, acid deposition. Efforts to control flood damage by channelizing and rip-rapping streams has also resulted in a loss of riparian vegetation, stream shading, channel structure and habitat complexity resulting in a loss of fish habitat quality in many reaches. Additional modifications to fish habitat will occur with the construction of an impoundment on the Elkwater Fork, a tributary to the Upper Tygart Valley River. The new reservoir will provide a source of drinking water for residents in the Tygart Valley, but will modify the hydrograph of the Elkwater Fork and inundate native brook trout (*Salvelinus fontinalis*) habitat in the area of the reservoir.

Streams on NFS lands originate on the western flanks of Cheat Mountain and generally flow in a west to northwest direction to the Tygart Valley River. Due to the land ownership patterns, the scattered parcels of NFS lands have relatively limited access and have remained comparatively undisturbed for several years. Habitat conditions on-Forest are generally good following the extensive logging that occurred around the turn of the last century. At that time, logging roads and railroad grades that crossed the watershed increased erosion and stream sedimentation, and streamside trees were cut down increasing stream temperatures and reducing the recruitment of LWD to stream channels. Today, much of the forested areas are recovering but streams remain modified. The loss of wood to the channels has reduced stream stability and habitat complexity and sediment levels in many reaches are elevated.

Contemporary impacts to streams on NFS lands are generally associated with the transportation system including roads, illegal ATV use and the rail line in the headwaters of the main stem. Road densities are relatively low on NFS lands, but they pose a risk of increased sedimentation to stream channels and illegal access to the watershed.

LWD plays an important role in the protection of forest streams. In particular, it is especially important in ephemeral and small intermittent streams. As trees fall into a channel their trunks provide a number of stream functions such as increasing habitat complexity, dissipating stream energy, maintaining channel structure and increasing channel stability. Available research on LWD varies on the “optimum” occurrence level. One research paper in particular (Dolloff, 1994, Fig. 2, pg.99), suggests that the loading of LWD in wilderness areas in the southern Appalachians averages about four to five pieces per 100 feet. These wilderness areas are areas that have never been logged or cleared. Additional consideration and research review may be needed in determining the “optimum” level of LWD for site-specific forest management activities.

The section of the Tygart Valley River between Valley Head and Huttonsville is stocked annually with rainbow trout and brown trout. From 1979 to 1982 approximately 1,000 to 2,000 brown trout fingerlings were stocked annually with poor success. Over 50 percent of the main stem of Tygart Valley River has been channelized above Valley Head.

Stream surveys were completed for several streams on National Forest System land in 1993. All the streams listed below contained populations of brook trout. The following table describes some of the characteristics of these streams:

Table 3.5 - Stream survey information

Stream Name	Length Surveyed	Average Gradient	Average Width	Pool/Riffle Ratio	LWD Occurrence
Becky Creek	3,050′	3.4%	33′	30:70	<1/100′
Laurel Run	2,040′	4.0%	3′	10:90	<2/100′
Big Branch	1,025′	3.0%	26′	30:70	<1/100′
Dry Run	3,015′	4.0%	14′	26:74	<1/100′
Peter's Run	1,220′	7.0%	17′	30:70	2/100′
McGee Run	7,786′	5.0%	17′	10:90	<1/100′
Stewart Run	14,067′	2.0%	15′	10:90	<1/100′
Windy Run	2,040′	5.0%	25′	30:70	1/100′

Streams in the Upper Tygart Valley River watershed support approximately 22 native fish species (Stauffer et al, 1995), the majority of which are nongame species. A number of nonnative species, such as brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*), have also been introduced into the watershed. No federally listed or sensitive fish species occur in the assessment area. Native brook trout are found in a number of streams throughout the watershed, and are considered a management indicator species (MIS) in the Forest Plan. Habitat objectives for management indicator species are to maintain or improve their habitat on NFS lands. Brook trout prefer streams with cold, clean water, a 1:1 pool to riffle ratio and abundant cover (USFWS 1982).

The ability of the Forest to protect or improve brook trout habitat varies by subwatershed and depends upon the amount and location of NFS lands in each subwatershed. Although NFS lands are fairly limited in the watershed, the potential exists to directly and indirectly influence a number of brook trout streams. The following information of fish populations was gathered in the 1980's:

- Riffle Creek – trout = 21.2 lbs./acre; total fish = 58.5 lbs./acre
- Back Fork of Riffle Creek – trout = 8.2 lbs./acre
- Laurel Run of Riffle Creek – trout = 5.4 lbs./acre
- McGee Run of Riffle Creek – trout = 35.0 lbs./acre; total fish = 43.7 lbs./acre
- Becky Creek – trout = 10.0 lbs./acre
- Big Branch of Becky Creek – 9.0 lbs./acre
- Hamilton Run, Clay Run, and Logan Run – trout ranged from 12.8 to 17.6 lbs./acre

- Ralston Run – trout = 15.8 lbs./acre
- Big Run – trout = 17.4 lbs./acre

The following is a general description of the sixth level subwatersheds that make up the Upper Tygart Valley River watershed and the amount of NFS lands in each.

Mill Creek subwatershed is 14,426 acres in size and is entirely on state and private lands. Brook trout can be found in the main stem of Mill Creek and its tributaries. Glade Run, Meatbox Run, Potatohole Fork and portions of the Mill Creek main stem are identified on the presumptive list of Tier 2.5 streams under the anti-degradation rule (West Virginia Department of Environmental Protection web site 2003). Tier 2.5 streams are those streams that support naturally reproducing trout populations, are identified as reference streams, or have a high biological rating that indicates high water quality.

Roads, logging, agricultural developments and acid deposition pose a risk to fish habitat in the subwatershed. In 1998, three streams (Glade Run, Meatbox Run and Potatohole Fork) were listed on the West Virginia Division of Environmental Protection 303(d) list as waterbodies impaired by acid deposition. They also appear on the draft 2002 303(d) list (WVDEP 2003), and are the only streams in the Upper Tygart Valley River watershed considered impaired by acid deposition. The geology in the subwatershed is primarily the Kanawha and New River formations of the Pottsville Group, which generally have poor buffering capabilities and are sensitive to acid deposition.

The Forest does not have a role in the protection of trout habitat in the Mill Creek subwatershed, but an understanding of the resource conditions within the subwatershed is important for considering the potential cumulative effects on the Upper Tygart Valley River.

Becky Creek subwatershed is 9,068 acres in size and 32 percent (2,874 acres) is on NFS lands. Becky Creek begins on Cheat Mountain and flows in a north to northwesterly direction to its confluence with the Tygart Valley River. NFS lands are located primarily in the headwaters of the tributaries that feed Becky Creek, while the main stem and lower tributary reaches are primarily in private ownership. State lands within this subwatershed include the Becky Creek Wildlife Management Area.

Major streams in the subwatershed include Becky Creek, Dry Run, Big Branch, Peter's Run, Whetstone Run and Wamsley Run. Brook trout have been reported in Becky Creek, Dry Run, Big Branch and Peter's Run (USFS 1994, unpublished report). Becky Creek and Big Branch are on the presumptive list of Tier 2.5 streams. Brook trout may be present in other streams of the subwatershed, but the data was unavailable.

Streams within the areas surveyed generally had moderate to high gradients (three to seven percent), with 30 percent pool area and very low levels of LWD. Conditions today are likely similar, although some habitat changes may have occurred from subsequent flooding. The amount of pool area is relatively good and as timber stands adjacent to the

streams mature and recruit additional LWD to the channels, pool area and quality should increase.

Water quality is considered good, and no streams within the subwatershed are currently listed on the 303(d) list of impaired streams. Alkalinities ranged from 30-75 ppm in the earlier surveys, and macroinvertebrate samples collected in Becky Creek and Wamsley Run, from 1996-1998, indicated good water quality (Tetra Tech, Inc., 2000). Limestone soils near the ridgeline of Cheat Mountain contribute to the buffering capacity of the streams and good water quality.

Roads, logging, agricultural developments and flood control efforts pose a risk to water quality and fish habitat conditions within the subwatershed. Much of the subwatershed has slopes that are 30-70 percent. The flatter valley bottoms are generally privately owned and converted to fields and pastures.

The ability of the NFS to protect and improve brook trout habitat primarily focuses on improving road conditions within the subwatershed. Road densities are relatively low, but the road locations are typically in close proximity to stream channels. Given the ownership patterns and steep slopes in the subwatershed, re-locating roads has limited applications, so improving the existing road conditions is the best opportunity. Increasing the number of cross drains and improving the road surfacing can help reduce sediment generated from roads. Properly closing any unnecessary roads can also reduce potential road related problems including illegal ATV use.

Tygart Composite 1 subwatershed is the largest subwatershed in the Upper Tygart Valley River at 37,070 acres in size. The subwatershed includes the Tygart Valley River main stem and tributaries from just south of Huttonsville to Valley Head. NFS lands comprise 5,951 acres (16 percent) of the subwatershed, and all are located on the eastside of the Tygart Valley River main stem, primarily in the Stewart Run drainage. The remainder of the subwatershed is in private and state ownership, including portions of the Huttonsville State Farm and Becky Creek Wildlife Management Areas.

Brook trout can be found in a number of streams within the subwatershed and have been reported in all of the streams that are included on the presumptive list of Tier 2.5 streams (Rafe Run, Hamilton Run, Clay Run, Elkwater Fork, Mowry Run, Limekiln Run, Stewart Run and Conley Run). In addition to the streams on the Tier 2.5 list, brook trout were also reported in Stony Run and may inhabit other streams in the subwatershed. Recent fish sampling in the middle reaches of Stewart Run collected five different species including brook trout, mottled sculpin (*Cottus bairdi*), blacknose dace (*Rhinichthys atratulus*), longnose dace (*Rhinichthys cataractae*) and creek chub (*Semotilus atromaculatus*).

The most recent surveys on NFS lands were conducted on Stewart Run in 1996 and 2002. The lower reaches of Stewart Run have a low to moderate gradient (two to three percent) and increases to 12 percent in the headwaters. Channel conditions vary between plain bed, pool:riffle mix, bedrock, and step pool types. Streams with plain bed characteristics

generally have poor pool development and little habitat complexity. Habitat complexity increases towards the headwaters as the gradient increases and the channel type changes to bedrock and step pools. Stewart Run was also surveyed in 1988 and the conditions in the lower reaches are consistent with the more recent surveys (Table 3.5). The gradient was 2 percent, pool habitat was approximately 10 percent of the stream area and the pieces of LWD were very low.

Water quality is considered good and no streams within the subwatershed are currently listed on the 303(d) list of impaired streams, although macroinvertebrate samples in Poundmill Run indicate degraded conditions (Tetra Tech Inc., 2000). Water samples collected near the mouth of Stewart Run in the fall of 2001 and spring of 2002 were considered good with a pH near eight in both samples.

The majority of the subwatershed is in private and state ownership. Fish habitat conditions are subject to modification due to roads (such as Highway 219 which runs the length of the subwatershed along the Tygart Valley River), logging, agricultural developments, and flood control efforts. Habitat and flow conditions in the Elkwater Fork will also be changed by the construction of a dam that is proposed.

The best opportunity for the NFS to protect and improve brook trout habitat within the Upper Tygart Valley River watershed is along Stewart Run. Stewart Run is the one stream in the watershed where a significant portion of the main stem and tributaries are on NFS lands. There are no Forest System roads along the lower reaches on NFS lands and access is limited along much of the channel although the WVDNR accesses wildlife openings along the stream in the middle reaches. It appears that ATVs are also accessing this area from FR 785 which can impact the channel and floodplain. Pool habitat quantity and quality should improve as timber stands adjacent to the stream channels mature.

Tygart Composite 2 subwatershed is approximately 11,753 acres in size of which 4,469 acres (38 percent) are NFS lands. The remainder of the subwatershed is in private and state ownership which includes the Huttonsville State Farm Wildlife Management Area. The subwatershed comprises the Tygart Valley River main stem and tributaries from Mill Creek, WV to just south of Huttonsville, WV. NFS lands are primarily located in the headwaters of Donley and Moss Runs draining Chestnut Ridge, and in the headwaters of Riffle Creek and its tributaries on Cheat Mountain.

Brook trout have been reported in Riffle Creek, Back Fork of Riffle Creek, McGee Run and Laurel Run. These streams, with the exception of Laurel Run, are also listed on the presumptive list of Tier 2.5 streams.

Streams in the subwatershed were heavily scoured by floods in 1996 which modified habitat conditions. Channels still appear scoured and entrenched in some areas on-Forest. Subsequent flood control efforts, such as the rip-rapping along the main stem of Riffle Creek, have modified fish and riparian habitat conditions in the lower reaches off-Forest.

Stream surveys on NFS lands were conducted in 2002 on Back Fork and McGee Runs. Channel types observed were predominantly step pool, pool:riffle and bedrock. Reach gradients ranged from 3-14 percent and a number of waterfalls were identified on McGee Run. Prior surveys occurred in 1992 on McGee Run and Laurel Run. Habitat conditions were similar to other streams in the watershed that were surveyed at that time. The streams had limited pool habitat, often less than 10 percent of the stream area, and very little LWD.

Water quality in the subwatershed is mixed. The presence of trout generally indicates good water quality, but Riffle Creek is on the draft 303(d) list for conditions not allowable (CNA) in state waters - biological impairment (WVDEP 2003), and macroinvertebrate samples in McGee Run indicate degraded conditions (Tetra Tech., 2000). The causes of impairment are unknown but could be related to sediment, other pollutants or acidity. Limestone soils are prevalent in the watershed, so the streams should be well buffered and have good pH levels.

Similar to the other subwatersheds, the majority of the Tygart Composite 2 is in private and state ownership. Fish habitat conditions are subject to modification due to roads, logging, residential and agricultural developments and flood control efforts. Highway 250 bisects the subwatershed running along Riffle Creek and crossing the lower reaches of Laurel Run, McGee Run and Back Fork.

The road density on NFS lands located north of Highway 250 is the highest for NFS lands in the watershed. FR 765, FR 765A and FR1560 are located at the headwaters of McGee Run and Back Fork and provide opportunities to reduce road related problems in the subwatershed. Opportunities include pulling or replacing undersized culverts and obliterating any unneeded roads.

Upper Tygart Valley Composite subwatershed is approximately 24,374 acres in size of which 3,323 acres (14 percent) are NFS lands. The remainder of the subwatershed is in private ownership. The subwatershed comprises the main stem and tributaries of the Tygart Valley River from its headwaters to Valley Head. Tributaries include Ralston Run, Mingo Run, Windy Run, Logan Run and Big Run. NFS lands are located east of the main stem and Highway 219, primarily along Windy Run and the headwaters of the main stem. Small parcels also occur in the Logan Run and Big Run drainages.

Brook trout have been reported in Ralston Run, Windy Run, Logan Run and Big Run. They may also occur in other streams within the subwatershed, but the information was unavailable. The streams that have had brook trout reported in them are also included on the presumptive list of Tier 2.5 streams.

Recent fish surveys on NFS lands were conducted in 2002 in Windy Run and in the headwaters of the Tygart Valley River just west of the “Big Cut”. Fish sampling in Windy Run collected brook trout and mottled sculpin with an estimated biomass of 6.7 lbs/acre and 4.8 lbs/acre, respectively. The brook trout biomass seems low and may indicate fishing pressure or other limiting factors such as stream flows or sediment. In

2002, sediment samples were collected in potential spawning sites in Windy Run and the fine sediment level (sediment less than four mm in size) averaged 23.3 percent. This level of fine sediment is at the point where we consider trout productivity to become impaired. Channel types observed were predominantly bedrock, pool:riffle mix and step pool mix. The channel types indicate some pool development likely associated with bedrock outcrops and boulders. The stream gradient ranged from four to nine percent. Windy Run was also surveyed in 1990 and pools represented 30 percent of the stream area, the gradient averaged 5 percent and the amount of LWD was low.

Fish sampling in the headwaters of the Tygart Valley River consisted of spot checking for fish using an electro-shocker and was not a systematic population survey. There is a waterfall approximately 20-25 feet high and above the falls no fish were found, while spot sampling below the falls collected one brook trout.

Water quality is considered good and no streams within the subwatershed are currently listed on the 303(d) list of impaired streams. Between 1983 and 1998, water quality samples were collected in Windy Run and Big Run as part of the West Virginia acid water studies (WVDNR 1999). During this time the pH in Windy Run averaged 7.34 and in Big Run the pH averaged 7.29, so the streams appear to be well buffered. Based on macroinvertebrate samples collected in 1996-97, Ralston Run had a stream condition index (SCI) of 74, on a scale of 0-100, which indicates water quality comparable or below average of reference sites (Tetra Tech Inc., 2000).

The majority of the subwatershed is in private ownership and fish habitat conditions are subject to modifications due to roads, logging, residential and agricultural developments and flood control efforts. Highway 219 bisects the subwatershed, running along the Tygart Valley River main stem and crossing the lower reaches of tributaries.

NFS lands within the subwatershed are primarily within the Windy Run drainage and the headwaters of the Tygart Valley River main stem. Small parcels are also located along the upper reaches of Big Run and within Logan Run and other unnamed tributaries to the Tygart Valley River. Opportunities to protect and improve brook trout habitat on NFS lands are associated with reducing sedimentation due to roads and improving pool habitat. The highest priority in the subwatershed would be to close an old jeep road that runs along Windy Run on NFS lands. The road is a source of sediment to Windy Run and illegal ATV use appears to be heavy in the area. An opportunity also exists to work with the railroad to stabilize a couple of small slides originating from the rail line just west of the “Big Cut”. The rail line passes through highly erosive Mauch Chunk soils in the headwaters of the Tygart Valley River that resulted in the slides.

Riparian Habitat

The existing Forest Plan developed guidelines for managing and protecting riparian habitat. Additional guidelines to protect riparian habitat have recently been adopted on a forest-wide basis. The new guidelines exceed West Virginia Best Management Practices (BMP) for controlling soil erosion and water siltation. The previous Forest Plan and

present WV BMP guidelines allow for some tree harvest and removal in riparian habitat. The new Monongahela National Forest guidelines establish minimum distances for no tree harvest/removal zones of 100 feet (measured from the edge of the stream bank) on each side of perennial and large intermittent streams, 50 feet on each side of small intermittent streams, and 25 feet on each side of and above ephemeral stream channels.

The protection of riparian areas on NFS lands is important for stream shading and the recruitment of LWD in the watershed, especially considering the modification of riparian areas and reduced recruitment potential that has occurred off-Forest. As the timber stands adjacent to the streams mature, LWD recruitment should increase. The addition of wood to the channels should benefit habitat complexity and channel stability in the watershed.

Vegetation

Reference Condition

Evidence of human habitation in the New World, based on radiocarbon-dated evidence, began about 12,500 years before present (BP). At about this same time many large herbivores, such as the mastodon and giant bison that were common in North America, became extinct. It is generally known that large herbivores have a substantial effect on the composition and condition of the vegetation. Although the exact nature and condition of forests during this time period are unknown, the presence of these large herbivores in combination with fire adapted forest communities suggests that much of the forested land was relatively open and subject to regular disturbances (USDA Forest Service 2002).

Cultivation of agricultural crops, such as various forms of squash, began in the eastern woodlands about 5,000 BP. Indications of intensive plant husbandry (with native cultigens such as sunflower, knotweed, bottle gourd, little barley, and tobacco) by Native Americans began around 3,500 BP and were well established in some areas around 2,000 BP. Archaeological sites with wood, seed, charcoal, and pollen from plants that require disturbance (such as ragweed, goldenrod, sumac, and eastern red cedar) indicate significant subsistence agriculture beginning around 4,000 BP and becoming common around 2,000 BP. Widespread cultivation of maize, beans, and squash began around 1,000 BP in the eastern woodlands. Most of these Native American agricultural areas were established in the flood plains where sediment deposition from flooding assisted in soil fertility renewal. It is well known that extensive agricultural fields were in place for several hundred years in the eastern woodlands prior to the arrival of European settlers in the 15th century (Peacock 1998). Although it is not known if the floodplains of the Upper Tygart Valley River provided subsistence agriculture fields for Native Americans, it is important to note the disturbance of the eastern hardwood forest did not originate with colonial settlement.

Various uses of eastern hardwood trees by Native Americans included seed production (acorns, chestnuts, hickory nuts, etc.) and felling of trees for firewood and construction of dwellings. Management of the eastern hardwood forest through the use of fire was

important to native Americans for establishing forage for game animals and at times for driving the game towards groups of hunters. There is general agreement that these large populations of original inhabitants were advanced enough to significantly alter the vegetation of this region through the use of fire for subsistence agriculture, hunting, range management, and travel (Brown 2000). The frequency of pre-settlement fire in the Appalachian Mountains is estimated at 7 to 25 years in most areas and up to 100 years in protected coves. About 500 years BP over 60 percent of the population of Native Americans was eliminated in what is now the Eastern United States. It is estimated that some communities lost up to 98 percent of their population. This depopulation occurred around the time the first European explorers arrived on the North American continent. Diseases spread by the first explorers may have been the source of this significant population decline. When the first European settlers arrived, they found a closed canopy forest that was increasing in size and density (USDA Forest Service 2002).

European settlement had a much more profound effect on forests than the original inhabitants. Slash and burn agriculture along with the practice of "deadening" (girdling trees) were the primary methods for growing crops and grazing livestock. Most agriculture in the area was on a land rotation basis (when a parcel of land would no longer support agriculture use another parcel of land was selected) since commercial fertilizers were not readily available and modern farming practices that limit erosion were not utilized. These methods were practiced by the first settlers and continued for several generations.

Current Condition

Large-scale logging began when the construction of railroads allowed easier access to the mountains of West Virginia. Over 90 percent of the original Appalachian forest was dominated by hardwoods (Carvell 1986). Red spruce was a major forest type, at higher elevations. It is estimated over 1.5 million acres of spruce/fir forest covered the higher elevations of the Southern Appalachian Mountains in West Virginia, North Carolina, and Tennessee prior to European settlement. By 1860 this area was reduced by half. At the turn of the 20th century only 225,000 acres of the spruce/fir forest remained and by 1920 the number of acres had been reduced even further, to about 100,000 (USDA Forest Service 1975).

In the early to mid-1960s clearcutting became a valuable silvicultural tool on National Forest System land to correct individual tree harvests that were resulting in high-grading (the practice of cutting the best/largest trees and leaving lower quality and/or smaller trees). The high-grading or misapplication of selection harvest method occurred on the Monongahela National Forest from 1950 through 1965 (Berman, Conley-Spencer, and Howe 1992). The use of clearcutting became highly controversial in the 1970s (mostly due to visual concerns of clearcutting large tracts of land) resulting in a temporary timber harvest moratorium and the creation of the National Forest Management Act and the National Environmental Policy Act. The clearcut harvest method continues to be a valuable silvicultural tool on the Monongahela National Forest, although at a much reduced level.

Threatened/Endangered/Sensitive Flora

Running Buffalo Clover (RBC) *Trifolium stoloniferum*, formerly grew over a broad area of WV, Ohio, Kentucky, Indiana, Illinois, Missouri, Kansas, Nebraska, and Arkansas (Cusick 1989). Once widespread and common along streams and bison trails, RBC is considered extirpated from much of its historical range (Ostlie 1990) and prior to the discovery of two populations in WV in 1985 was thought to be extinct. This endangered plant thrives on Greenbrier Limestone formation calcium-rich soils in moderately disturbed sites with filtered sunlight such as old logging roads, jeep trails, fence rows, and hawthorn thickets (USDA Forest Service 1995). The Fernow Experimental Forest in Parsons, WV is conducting studies to determine to what extent RBC depends on disturbance in order to prevent further population declines. Efforts from this study will hopefully show to what extent RBC can be disturbed and if this must occur at certain times of the year, to prevent population declines.

Approximately 120,000 project acres (48560 ha) have been analyzed and/or surveyed for running buffalo clover in the past ten years. Through those surveys, running buffalo clover populations have been found on the Cheat/Potomac and Greenbrier Districts, occupying many of the running buffalo clover habitat types described above. The largest known population (estimated to be between 60,000 to 100,000 rooted crowns) of RBC was discovered during a botany survey of the Stewart Run Opportunity Area in 1995 - 1996. In WV a total of eighteen wild populations, eleven of which are on the MNF, are monitored annually (Harmon and Mitchell 1999). These populations contribute significantly to the viability of this species. No designated critical habitat exists on the MNF for running buffalo clover (USFWS 1989). There are seven running buffalo sites located on National Forest System lands within the watershed area. Surveys will be required in the Upper Tygart Valley Watershed project areas, prior to any ground disturbance activity.

Small whorled pogonia (SWP*)* *Isotria medeoloides*, was listed as endangered in 1982 when all known locations totaled less than 500 plants in 17 sites. In 1993, the USFWS proposed downlisting to a federally threatened species due to the discovery of three times the number of populations and 61 percent of the current viable sites being under permanent protection (www.endangered.fws.gov). SWP was first found on the MNF in 1997 in the Land Type Association (LTA) Bd03 (Eastern Allegheny Mountain and Valley Subsection, Slabcamp-Little Mountain System). Although sparse, this member of the orchid family is widely distributed, with a primary range extending from southern Maine through the Atlantic seaboard states to northern Georgia and southeastern Tennessee. Populations consist of plants that may be in any of four different states: 1) vegetative, 2) with an abortive flower bud, 3) flowering, or 4) dormant (SWP Recovery Plan). Because of it's potential dormancy, finding this plant can be extremely challenging. To date, the length of dormancy has not been substantiated. Associates are part of the indicator suite for a white pine ecological association, which occurs in southern and drier parts of the MNF. Based upon habitat requirements, this plant could exist throughout the MNF including the Upper Tygart Valley watershed, although only

one population has been found on the Marlinton/White Sulphur Ranger District. Botany surveys will be required to locate any SWP populations within this watershed on MNF lands prior to any ground disturbance activity.

Sensitive plant species found during the botany survey of 1995 – 1996 include:

- White Monkshood *Aconitum reclinatum*
- White Alumroot – *Heuchera alba*.

A variety of orchid species were also found during the survey.

Forest Type/Size/Density

Even-age regeneration methods may include two-age, clearcutting, and/or shelterwood harvests. A two-age harvest results in a residual basal area of 15 to 30 square feet of trees mostly in the poletimber and small sawtimber (8 to 16 inch dbh) size classes. The next entry for a regeneration harvest in stands receiving a two-age treatment would not occur for another 60 to 100 years. A clearcut harvest results in all trees over one inch dbh being cut with the exception of about five trees per acre are left for wildlife purposes. Another regeneration harvest would not occur in a stand receiving a clearcut treatment for 120 to 200 years. A shelterwood harvest results in a residual basal area of 30 to 50 square feet of trees mostly in the small and medium sawtimber size classes (12 to 22 inch dbh). Reentry in a shelterwood harvest would normally occur within 5 to 15 years after the initial harvest to remove the remaining sawtimber size trees if there is sufficient regeneration of desirable trees. With the exception of trees designated to remain, all other trees over one inch dbh are cut in a regeneration harvest.

Most of the areas clearcut in the 1960s and 1970s resulted in stands of overcrowded trees (too many trees trying to live in one area). Natural mortality can eventually reduce this overcrowding; however, through the utilization of timber stand improvement (TSI) techniques it is possible to select which trees will live and which trees will die. These TSI treatments are used to improve the health and increase the growth of woody stems in the forest by removing low quality, diseased, poorly formed, or less desirable trees thereby increasing the availability of nutrients, moisture, and sunlight for the remaining trees. One method of TSI is a non-commercial thinning in a crop tree release (CTR). Crop trees are selected based on species, mast capability, health, potential wood value, and form. The stands in this area that would be treated with CTR are now, or would be within the next five to ten years, in the poletimber size class. There is the potential to further improve the health and growth of these stands through commercial and non-commercial thinnings utilizing other various TSI methods.

Many stands that were clearcut in the Upper Tygart Valley Watershed in the 1980s and early 1990s are now overcrowded with young trees. These stands will be ready for a non-commercial thinning using the CTR method within the next five years. Most of these stands are presently in the sapling stage of growth.

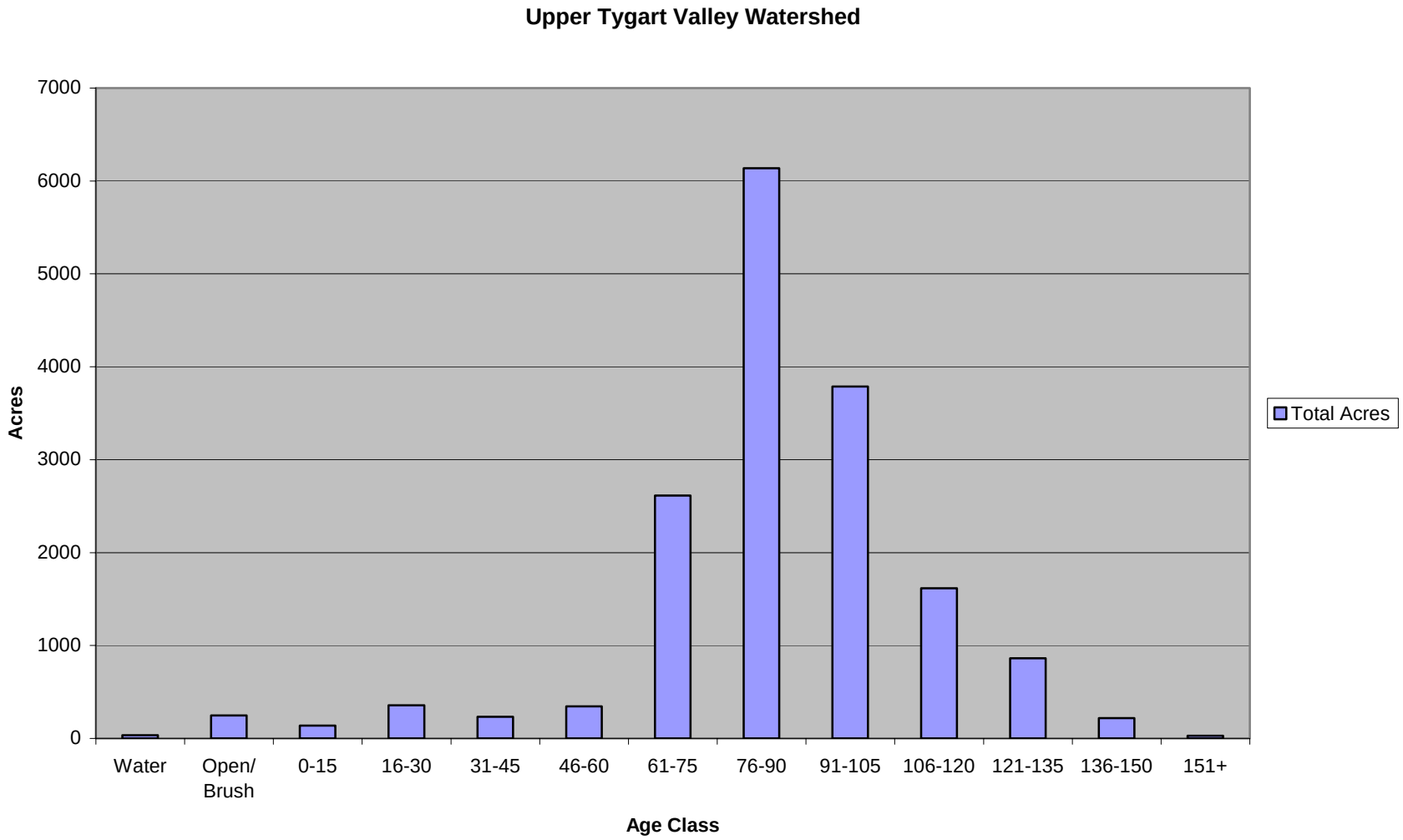
One type of commercial thinning is called an Overstory Removal (OSR). An OSR is usually done in a stand that has received a commercial thinning within the past 10 to 30 years. The first thinning may result in a substantial amount of regeneration, normally of tree species that are tolerant of shade such as sugar maple. The OSR harvest removes most of the overstory and releases the regeneration.

Forest Plan Standards and Guidelines for MP 6.1 indicate that forest diversity will be enhanced by the dispersal of different forest types and ages of vegetation. The normal rotation age (in MP 6.1) for high site mixed hardwood stands is 200 years and 120 years for black cherry, when the age classes are in balance. Rotation ages for low sites are 150 years for mixed hardwood stands and 100 years for black cherry. However, until the age classes are balanced, stands must be at least 70 years old to be considered for a regeneration harvest.

The table and bar chart on the following pages indicate, the age classes are presently out of balance. The extensive clearcutting that occurred around the turn of the 20th century created a mostly even-age forest. Over 85 percent of NFS land in the Upper Tygart Valley Watershed is presently in the four age classes between 61 to 120 years old with less than 5 percent in the three age classes of 0 to 45 years old. To have a balance of different aged stands, each age class should contain approximately seven to eight percent of the total acres. There is an opportunity in the next five to ten years to move toward more balanced age classes by utilizing even-age regeneration harvests and to improve the structure, diversity, and health of many stands through commercial thinning.

Table 3.6 -Upper Tygart Valley Age Class Acres by Sub-watershed (NFS Land only)

Age Class	**Upper Tygart Composite**	**Tygart Composite 1**	**Tygart Composite 2**	**Mill Creek**	**Becky Creek**	**Total Acres**	percent
Water	0	1	33	0	1	**35**	0.2
Open/Brush	10	165	44	0	28	**247**	1.5
0-15	68	0	69	0	0	**137**	0.8
16-30	40	118	59	0	139	**356**	2.1
31-45	131	14	9	0	78	**232**	1.4
46-60	102	86	141	0	17	**346**	2.1
61-75	864	385	1145	0	220	**2614**	15.7
76-90	1097	2307	2096	0	636	**6136**	37
91-105	483	1498	633	0	1173	**3787**	22.8
106-120	423	768	166	0	260	**1617**	9.7
121-135	35	485	74	0	270	**864**	5.2
136-150	68	97	0	0	53	**218**	1.3
151+	0	28	0	0	0	**28**	.2
Total	**3321**	**5952**	**4469**	**0**	**2875**	**16617**	100


Upper Tygart Valley Watershed
7000
6000
5000
4000
3000
2000
1000
0
Acres
Water
Open/ Brush
0-15
16-30
31-45
46-60
61-75
76-90
91-105
106-120
121-135
136-150
151+
Age Class
Total Acres

The United States (US) remains the largest producer of industrial timber to this day producing approximately 28 percent of the World total. Over the past 40 years the US annually produced about 25 percent of the total industrial roundwood. In addition to being the largest producer of wood products in the World (and second largest exporter, next to Canada), the US is also the largest importer of timber products. Overall the US is a net importer of wood products (USDA Forest Service 2002).

Timber harvesting on National Forest System lands has changed dramatically over the past 50 years. In 1950, National Forest System lands produced approximately 6.6 percent of the timber products in the US, by 1964 it had increased to 17.5 percent, but by 1998 had dropped to 3.5 percent (USDA Forest Service 2002).

Extensive timber harvesting occurred in this watershed prior to National Forest System ownership. Construction of railroads in West Virginia doubled in the 1880s and doubled again in the 1890s, allowing access to and transportation of the timber resource. By 1917 rail lines covered 3,705 miles in the state. The number of sawmills in West Virginia reached a peak in 1909 at 1,524. Production of lumber was highest in 1910 with mills employing 26,000 workers and producing 1,500 million board feet of lumber (Lewis 1998). Logging at the turn of the century clearcut the large majority of this portion of the state. For this reason the forest we have here today is mostly even-age (see Table 3.6).

Timber harvests for the purpose of multiple use management continues under NFS ownership. Becky's Creek, Back Fork, Shaver's Run (partially within the Upper Tygart Valley watershed), and Chestnut Ridge are National Forest System timber sales that have been completed within the Upper Tygart Valley Watershed since 1980. Within these timber sales, approximately 762 acres were harvested by intermediate cuts (thinnngs) and less than 500 acres were regenerated. The Mower Tract, mostly located within the Shaver's Fork watershed, was purchased by The Trust for Public Land and was deeded to the Monongahela National Forest in 1987-1988. Much of this land was heavily logged in the 1980s and early 1990s. The timber rights to the Mower Tract expired in 1992. Currently, there are no active timber sales on National Forest System land in the Upper Tygart Valley watershed.

Timber harvesting also continues on private land. Diameter limit cuts and selection cuts are the most common harvest methods on other private lands. Diameter limit harvest methods remove most of the trees above a certain diameter measured at about one foot above ground level. The selection harvest method removes only individual trees that have been marked for cutting.

A variety of forest types are found within this watershed due to a range in elevation from approximately 2,000 to 4,700 feet, varying slope aspects, flat ridgetops and broad valleys offering a diversity of tree and shrub mast species for wildlife including: oaks, aspen, butternut, hawthorn, black cherry, serviceberry, dogwood, and sassafras. American chestnut is still present as an understory species. On the following pages is a table showing the number of acres of each forest type and a pie chart showing the percentage

of acres of each forest type found on National Forest System land in the Upper Tygart Valley watershed.

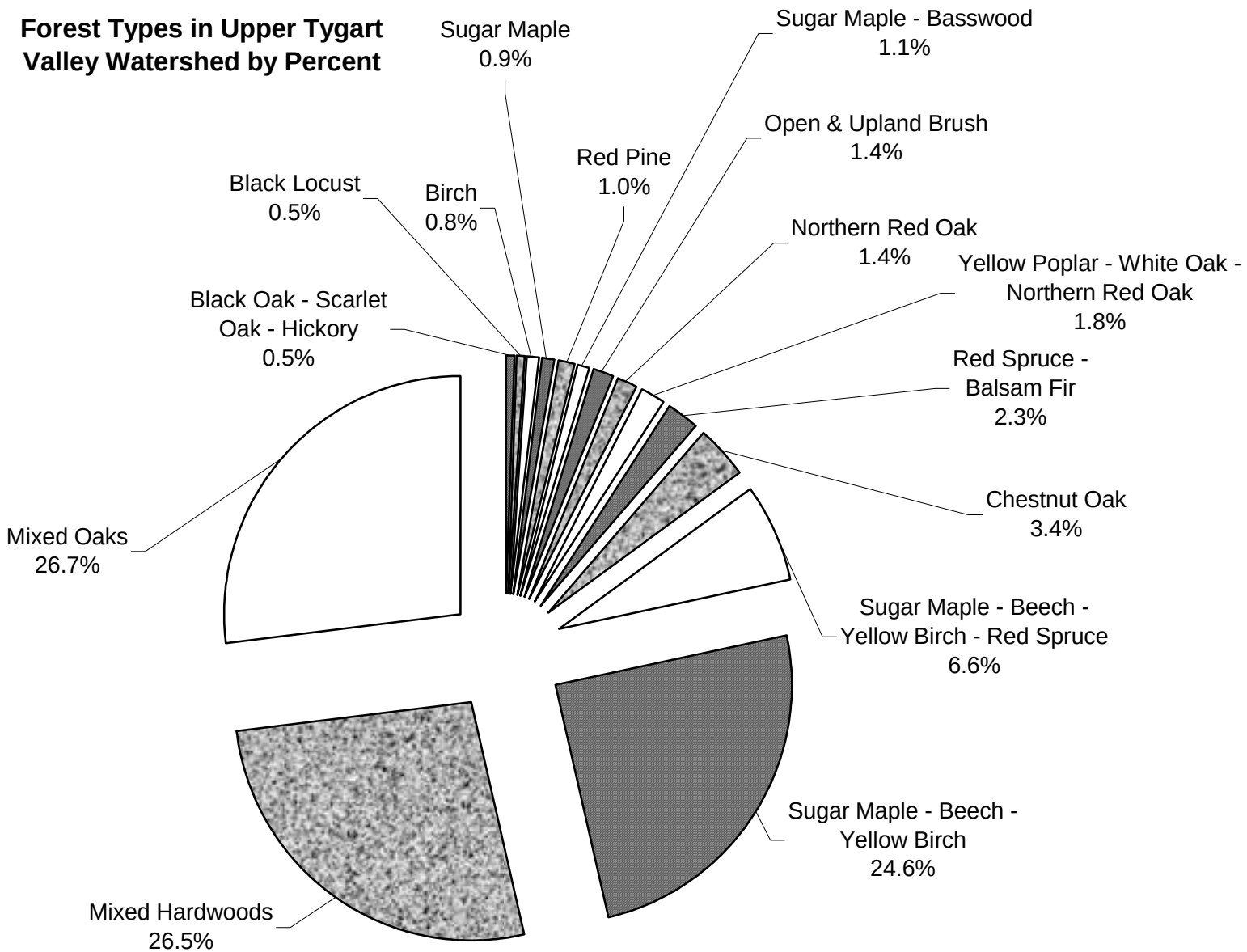
Table 3.7-Upper Tygart Valley Forest Type Acres by Sub-watershed (NFS land only)

Forest Type*	Upper Tygart Composite	Tygart Composite 1	Tygart Composite 2	Mill Creek	Becky Creek	Total Acres	%
Water	0	1	33	0	1	**35**	0.2
2	29	52	6	0	79	**166**	1
5	0	0	1	0	7	**8**	0.05
13	218	105	2	0	50	**375**	2.2
49	0	0	13	0	0	**13**	0.1
52	0	336	161	0	65	**562**	3.4
53	0	86	0	0	0	**86**	0.5
54	0	0	8	0	0	**8**	0.05
55	19	99	22	0	89	**229**	1.4
56	35	235	8	0	19	**297**	1.8
59	477	1957	1227	0	774	**4435**	26.7
81	1285	1094	463	0	1241	**4083**	24.6
82	141	0	37	0	0	**178**	1.1
83	21	0	6	0	0	**27**	0.2
85	0	84	35	0	24	**143**	0.9
86	0	0	2	0	0	**2**	<0.05
87	836	132	3	0	129	**1100**	6.6
88	0	86	5	0	0	**91**	0.5
89	237	1466	2393	0	300	**4396**	26.5
92	13	54	0	0	69	**136**	0.8
98	0	45	12	0	0	**57**	0.3
99	10	120	32	0	28	**190**	1.1
Total	**3321**	**5952**	**4469**	**0**	**2875**	**16617**	100

*See Appendix A for list of codes

The following forest types (not shown in the pie chart) were also identified in this watershed but comprise less than 0.5 percent of the National Forest System acres:

Forest Type Code	Forest Type	%
5	Hemlock	0.05
49	Oak–Yellow Pine	0.1
54	White Oak	0.05
83	Black Cherry–White Ash–Yellow Poplar	0.2
86	Beech	<0.05


Forest Types in Upper Tygart Valley Watershed by Percent
Sugar Maple 0.9%
Sugar Maple - Basswood 1.1%
Open & Upland Brush 1.4%
Red Pine 1.0%
Black Locust 0.5%
Birch 0.8%
Northern Red Oak 1.4%
Yellow Poplar - White Oak - Northern Red Oak 1.8%
Black Oak - Scarlet Oak - Hickory 0.5%
Red Spruce - Balsam Fir 2.3%
Chestnut Oak 3.4%
Mixed Oaks 26.7%
Sugar Maple - Beech - Yellow Birch - Red Spruce 6.6%
Sugar Maple - Beech - Yellow Birch 24.6%
Mixed Hardwoods 26.5%

Insects, Disease, and Non-Native Invasive Plants

The role of non-native insects, diseases, and invasive plants as disturbance factors has increased in the past century due to the introduction of these pests from other countries. Presently there are approximately 50,000 species that have been introduced into the United States. Nearly 5,000 non-native plant species now exist in natural ecosystems in this country including an estimated 138 tree and shrub species that have invaded our native shrub and forest ecosystems. The costs of controlling these species combined with the economic loss of commercial products are estimated to be in the billions of dollars each year. (Pimental, Lach, Zuniga, and Morrison 1999).

Some of the species known to influence the structure and pattern of vegetation are discussed below. The species listed here are not all inclusive of non-native insects, diseases, and invasive plants that may be present in the Upper Tygart Valley watershed.

Insects

Gypsy Moth (*Lymantria dispar L.*) was introduced, from France, to the United States in 1869. The first defoliation outbreak occurred in 1889 (McManus, Schneeberger, Reardon and Mason 1989).

A population crash of the gypsy moth, caused by the fungus *Entomophaga maimaiga*, kept the population under control for the past few years. High humidity, frequent periods of rain, and fairly constant temperatures between 14°C to 26° C are needed for the fungus to germinate and spread (Reardon and Hajek 1998). An increase in the number of gypsy moth egg masses on the Forest this past year is resulting in a population build-up causing defoliation in numerous "hot spots" in the eastern section of Pocahontas County. The population increase, due to dry spring weather for the past two years, should not cause significant tree mortality this year. However, a continued increase in the population with successive years of defoliation may cause extensive tree mortality. A return to a control program may be necessary to slow the spread of this insect and reduce tree mortality.

Oak trees (especially of the white oak group) are the preferred host for this insect pest. Less than 50 percent of the trees on National Forest System land in the Upper Tygart Valley watershed are oak. About half of these are in the white oak group. This area is considered to be moderate to high risk (Gottschalk 1993) for massive defoliation by gypsy moth caterpillars.

Hemlock Wooly Adelgid (HWA) (*Adelges tsugae*): This sapsucking insect, introduced to the United States from Asia in 1924, was detected in Pocahontas County in 1993 (Hutchinson 1995). The insect feeds on twigs causing the foliage to discolor and drop prematurely. Defoliation and death usually occurs about five to seven years after a tree is infested. Eastern and Carolina Hemlocks are highly susceptible to this insect and no resistant trees have been located to this date. However, several common predators (including the Japanese Ladybug) of the adelgid have been released and may prove to be an effective control (Kajawski 1998; Montgomery and Lyon 1996). Severe cold weather also seems to control HWA. In January, 1985 and the winter of 1993-1994 severe cold weather (-20° to -28° F) greatly reduced HWA populations (Souto, Luther, and Chianese 1995). Infestations of HWA are not apparent above the Hudson River corridor in New York. It appears cold weather may be a limiting factor in the spread of this insect. The cooler climate at some of the higher elevations of the Upper Tygart Valley watershed may help to limit the impact of this

exotic pest. Although there are no known reports of the adelgid in this watershed, it has been found along the northern boundary in an adjacent watershed.

Emerald Ash Borer (EAB) (*Agrilus planiplennis)*: Although not presently known to occur in West Virginia, this insect from Asia was identified in 2002 in southeastern Michigan. There is evidence this non-native pest has been established in Michigan for at least five years and has spread into Ohio. Infestation is difficult to detect until crown dieback begins to occur. D-shaped exit holes on the branches and trunks of ash trees are evidence the adult insect is present and damage to the cambium layer has already occurred from feeding larvae. The adult insect feeds on the leaves of the tree. Trees may die within two to three years of active infestation (USDA Forest Service 2002). There is no known natural resistance to this pest. Flying adult insects may travel as far as one mile in a year. Insecticides may be applied through trunk injections or soil drenches to kill larvae in individual trees that have not yet been severely infected or as foliar sprays to kill the adult insects.

Disease

Beech Bark Disease (BBD*):* The beech scale insect (*Cryptococcus fasigua*), native to Europe, arrived in Nova Scotia around 1890. By 1932 trees in Maine were dying from BBD. The disease results when the bark is attacked by the beech scale, then invaded by fungi, primarily *Nectria coccinea* var.*faginata* and *N.galligena* which eventually kills or severely injures beech (Houston and O'Brien 1983). Beech trees over eight inches diameter are more severely affected then smaller trees. Mortality occurs in about 30 percent of the trees that are infected. Up to 90 percent of the remaining beech trees in a stand become severely injured and do not produce quality wood (Leak and Smith 1996). It appears there are greater disease levels in stands containing hemlock (Gavin and Peart 1993). Hemlock provides high shade and moisture preferred by the fungi that attack the tree after infestation by the scale.

The scale is presently in the Upper Tygart Valley watershed and the fungi have killed many trees within this watershed and adjacent watersheds. Cutting infected and high risk trees would provide an opportunity to salvage some of the material and improve the health and diversity of the stand (Ostrofsky and Houston 1988).

Chestnut Blight (*Cryphonectria parasitica*): This fungus (probably introduced through the importation of chestnut trees from Asia) was first reported in the United States in 1904. Within 50 years the fungus occupied the entire range and had killed 80 percent of the American chestnut (Kuhlman 1978). Nearly all the remaining live trees were infected with the fungus and dying. Prior to the infestation, the American chestnut was a major component of the eastern hardwood forest comprising 25 percent of all tree species on over 200 million acres from New England to Georgia (MacDonald, Cech, Luchok, and Smith 1978; and Schlarbaum 1989). This tree, which once grew up to 120 feet tall and over 7 feet in diameter, now rarely attains heights over 30 feet with diameters up to 6 inches before the fungus kills the stem and the process starts over when the tree resprouts. A few resistant trees have been found. There is hope that some time in the future the American chestnut will return, as a valuable timber and wildlife tree, to the eastern hardwood forest (Newhouse 1990). An opportunity exists to plant disease resistant chestnut in this area.

Butternut Canker *(Sirococcus clavigignenti-juglandacearum)*: This disease was first reported in the United States in southwestern Wisconsin in 1967. In 1979 the newly described fungal species *Sirococcus clavigignenti-juglandacearum* was discovered as the causal agent. Although the origin of this fungus is still unknown, it is suspected that it was introduced because of the rapid spread, highly aggressive nature of the

disease, and lack of resistance by native butternut trees. Approximately 80 percent of the butternuts have died (Ostry 1997). Butternut has been listed as a sensitive species of special concern by the USDA Forest Service due to its increasing rarity. Dead and dying butternut trees have been found on the Monongahela National Forest. There may be some resistance to the disease since some healthy butternuts continue to grow adjacent to infected trees. Efforts continue to identify apparently healthy disease resistant trees for future cultivation.

Non-native Invasive Plants

Multiflora Rose *(Rosa multiflora* Thunberg.): Also known as Japanese Rose, has been widely planted for erosion control and wildlife benefits. It was brought to the United States in the 1880s by horticulturists. This shrub forms dense thickets impenetrable by humans or large animals and is highly competitive for soil nutrients. It grows just about anywhere except in standing water or extremely dry areas (www.vnps.org/invasive). Control methods include mowing several times per year for two to four years, burning early in the growing season with follow-up burns for several years, digging up the plant with the entire root, applying glyphosate or other approved herbicides, or to the cut stems or foliage. (www.caf.wvu.edu)

Autumn Olive *(Elaeagnus umbellate* Thunberg.): Introduced from east Asia in the 1830s for revegetation of disturbed areas. This shrub has prolific fruiting ability. The fruit (and seed) is eaten and dispersed by birds. Autumn olive can thrive in poor soils and does not require much moisture to survive. When cut or burned it sprouts and grows rapidly forming a dense shade cover which makes it difficult for sun-loving plants to compete with it. This plant does not grow well on wet sites or under forest shade conditions. Control methods include pulling up seedlings and sprouts when the ground is moist or applying glyphosate, or other approved herbicides to cut stems or foliage. (www.caf.wvu.edu)

Tartarian Honeysuckle (*Lonicera tatarica* L.): Most bush honeysuckles are natives of Europe or eastern Asia and have been cultivated in the United States since the mid-1800s. This plant was valued for its fragrant flowers and berries eaten by birds which then disperse the seeds into other areas. Honeysuckles can form dense shrub layers and interfere with the germination and growth of native plants (www.vnps.org/invasive). Control methods include digging up the plant and entire root and repeated burning or cutting during the growing season. Cutting should be done twice per year, once in the spring and once in the summer. Any cutting during the dormant winter months would increase resprouting. Applying glyphosate near the end of the growing season to the foliage or freshly cut stumps is an effective control method. (www.caf.wvu.edu)

Garlic Mustard (*Alliaria officinalis*): Native to Europe, this biennial plant is one of a few alien herbaceous species that can invade and reduce native deciduous forest understory species. It was first recorded in the U.S. about 1868 on Long Island, NY. Garlic mustard has historically been used as a potherb and contains high amounts of vitamins A and C. It is most common in river associated habitats but can also invade drier, upland forests. Seeds germinate in late winter/early spring when most other native herbaceous plants are still dormant. A single plant can produce thousands of seeds that may remain viable in the soil for up to five years. The best control method (if hand pulling is not practical) is to prevent initial establishment by cutting flowering stalks at ground level. Cut plants should be removed from the infested area. Once it is well established, the plant is extremely difficult and costly to control. Some butterfly species may be adversely affected by this plant by mistaking it for a native toothwort; however, the chemicals in garlic mustard appear to be toxic to some butterfly species eggs and larvae.

(www.nps.gov)

Tree of Heaven (*Ailanthus altissima*): Native to central China, this plant was introduced to the U.S. by a Philadelphia gardener in 1784. It is usually found in disturbed areas, especially near cities, but may also invade undisturbed areas. The tree is able to reproduce from stump or root sprouts and from seed. The seed is very light and is easily dispersed by wind. One tree can produce 325,000 seeds per year. Lifespan of this tree is usually less than 50 years but it grows rapidly (attaining a height of over 60 feet) and manufactures a substance that is toxic to other plants. Numerous methods of manual, mechanical, and chemical control can be used to reduce the spread of this plant. The best control method is to pull the seedlings when the soil is wet and loose before they are large enough to produce seeds. (www.nps.gov)

Musk Thistle (*Carduus nutans* L.): Native to western and central Europe, Asia Minor, and North Africa, this plant is listed as a noxious weed in West Virginia. It was first reported in 1852 in central Pennsylvania and spread to the Midwest by the turn of the 20th century. This normally biennial plant is capable of forming dense stands on disturbed sites and pastureland. A single plant usually has 1 to 40 seedheads but may produce over 600 seedheads per year with 125 to as many as 1,000 seeds per seedhead. Seed dispersal by wind is usually within 100 meters of the plant but streams, ants, birds, animals, and humans transport the seed for much longer distances. The seeds can remain viable in the soil for 15 years or more. Musk thistle is mainly a problem on range or grass lands but can also be found under a dense forest canopy where recent soil disturbance has occurred. Correct identification of this plant is critical since it is similar to native thistles. Once the plant has been accurately identified an integrated management program to prevent seed production should be established. Chemical (herbicides), physical/mechanical (mowing or tilling), and biological (insects or disease) methods, are available in combination with the establishment of native plants for the effective control of this noxious weed. (www.nps.gov)

Purple Loosestrife (*Lythrum salicaria*): This plant occurs exclusively in wetland habitats. Although it is not known if this plant occurs in the Upper Tygart Valley watershed, it is listed here because once established it becomes highly invasive and is extremely difficult to eradicate. Native to Eurasia, it was brought to Canada and the northeastern United States in the early 1800s. Pure, dense stands of up to 80,000 stems/acre choke out native plants and endanger not only other plants but amphibians as well. One stalk may produce up to 300,000 seeds that are spread by wind and water. In addition, purple loosestrife propagates vegetatively by root or stem segments. Control in its native country is by herbivorous beetles that feed on its roots and leaves. Hand removal is possible in small populations except after flowering which would aid in scattering the seeds. Pulled plants should be bagged on site and removed since root or stem segments left behind would produce more plants. Once the plants are removed from the area they should be burned. Several treatments with herbicides registered for aquatic use may also aid in control. Care should be taken when using herbicides to avoid contact with non-target native plants since the native plants will be needed to recolonize the area. (www.consci.tnc.org/library/pubs/dd/loosestrife)

Agriculture/Openings

Less than two percent, about 247 acres (see Table 3.6) of National Forest System land in this watershed is in grassy or brushy openings. There are no grazing allotments on National Forest System land in this watershed.

Approximately 86 percent of the entire watershed (private and public land) is forested. (www.wvwrc.org/Watersheds)

Wildlife

Reference Condition

The National Forest System in this watershed has historically been mostly forested land. There have been changes over the years from timber harvest, fires, clearings for settlement, and mining, but for the most part the area has remained mostly forested. The spruce forest was more extensive in the past than currently, so the animals unique to that habitat type were, most likely, more numerous.

Some records are available which give an indication of wildlife species present before European settlement in Nicholas and adjacent counties. The woods sheltered and fed a world of animal life: bears, deer, panthers, wolves, foxes, wildcats, raccoons, otters, minks, beaver, weasel, skunks, groundhogs, squirrels, rabbits, muskrats. Prior to European settlement an estimated 23-40 million whitetail deer occupied a range similar to that of today. However massive commercial and food exploitation by settlers resulted in the whitetail's near extinction.

Black bear was abundant throughout WV at the time of settlement. Counties began paying bounties on bear beginning in early 1800. Hunted and persecuted, the bear retreated to the forested mountains of WV were a population of about 500 clung on precariously.

Elk and buffalo were found occasionally in the early days. Bird life was prolific. Opossums, rats, and mice followed the settlers from the east where they had their natural habitat or had been imported from Europe. Red fox brought from England by Virginia Sportsmen soon became an associate of the native gray fox. Turtles, frogs, toads, lizards and snakes were common everywhere. Fleas, bees and houseflies were not native to the forest but came with the settlers. Wild bees found in the woods had escaped from the colonies and spread through woods ahead of settlements. Great flocks of passenger pigeons were seen in the early fall days. (From History of Nicholas Co., W.F. Brown, 1954. The Dietz Press, Inc., Richmond, VA).

Threatened/Endangered/Sensitive Fauna

Mountain lions, wolves, bison, elk, and fishers were at one time common here but were hunted to extinction. There are 67 native mammals known to occur currently or in recent history in WV. The bison, once common in precolonial days along the major river systems, was eliminated in the state by 1825. Elk were gone by 1890, and the last wolf in the state was killed in 1900. Although occasional reports of sightings of wild mountain lions recur, their presence in the state has not been confirmed. Porcupines once were present in the high coniferous forests, but they disappeared as the spruce declined. The beaver was once abundant throughout the state, but was extirpated by 1923. It was reintroduced during the 1940s in several counties, including Pocahontas. Since that time, it has proliferated and is again fairly common on the National Forest System.

Current Condition

A brief, annotated list of WV mammals by Thaddeus Surber was first published in 1909 in a report of the WV Fish & Game Protective Association. The first WV mammal list based on systematic trapping was compiled in 1937 by Remington Kellogg of the U.S. National Museum. This list included 64 native and 3

introduced species. The WV Conservation Commission (now the WVDNR) began a major study in 1948 to determine the distribution of the mammals in the state. The final report (McKeever 1952) summarized the distribution of each mammal within the state as well as the history, ecology, and economic value of each species.

A variety of habitats supporting terrestrial mammals is present throughout the Upper Tygart Valley watershed. Based on forest types, soils, geology and LTA designations within the Upper Tygart Valley watershed, it is safe to assume mammal populations are stable. Many small mammals found throughout Upper Tygart Valley watershed are considered habitat generalists with little threats to any species overall viability. Dated (WVDNR, 1990 Small Game Bulletin) small game harvest information is available from the WVDNR however it is difficult to provide small game harvest information usable at the watershed level. The Upper Tygart Valley watershed is almost entirely located within the WVDNR Cheat Wildlife Management Area. Annual Big Game bulletins published by the WVDNR display deer, turkey and bear harvest information by county and WMA. Harvest information is readily available and used to estimate populations within specific areas. Communications with Shawn Head (WVDNR) reflect the over zealous population objectives listed in the Forest Plan, for game species. Current game species populations appear to be stable, but are also dependant upon environmental conditions not controlled thru harvest. Population fluctuations can be attributed to mast failures and harsh winter weather conditions.

Small mammal surveys have not occurred within the watershed. Sampling is a challenge as most mammals are generally secretive and difficult to observe. Their populations are dynamic, changing in abundance and distribution as habitats are altered either by man or nature. In 1969, eight fishers were reintroduced into Pocahontas County, but it is unknown if this population has flourished.

Winter bat surveys are conducted in many of the states' hibernacula. Overall, bat populations are stable or increasing for species wintering on the Monongahela. Population declines can be attributed to human disturbance during hibernation, and to a lesser degree, environmental factors (flooding within caves, ceiling collapse, or changes in microclimates due to changes in airflow). Population decreases due to direct human disturbances within caves is becoming less of a concern as hibernacula are gated to prevent uncontrolled human entry. Summer bat surveys have been conducted in and around the Monongahela National Forest since 1998 including six areas within the watershed. Information from these surveys has shown that previously thought rare bat species, are actually more widespread within the forest than originally thought. We can tell by looking at mammary gland conditions and weigh the chronology of reproductive activity for different bat species. It has helped identify the need to find relationships between bat roosting and foraging habitats. Although data has been collected, specific scientific analysis has not been conducted so population levels and species distribution are unknown. Surveys and monitoring are critical elements of the Biological Opinion for the Monongahela National Forest by USFWS.

General invertebrate sampling and analysis have not been conducted within the watershed or adjoining areas so population levels or trends are unknown. The exception to this are limited cave surveys and inventories conducted by the WVDNR. These inventories may be outdated and new invertebrate information is needed.

Several specific bird projects have recently occurred on the Monongahela National Forest. Breeding bird transects have been run throughout the Monongahela. A Forest songbird abundance and viability study was also conducted in the late 1990's. Results of these studies suggest that the Monongahela National Forest is providing abundant habitat for Neotropical migrants and interior species. Forest fragmentation effects are evident only at the local scale, and distinct only within 25 m of edges; And with the exception of a few

species, bird abundance and species richness in riparian zones investigated were little different from those on upland sites (Demeo 1999).

Recently, Partners in Flight (PIF) has developed priority bird species and habitats for physiographic areas across the U.S. In general, the Monongahela lies in the Mid-Atlantic Ridge and Valley (Pashley, D.N. et al 2000). The priority bird species and habitats for this region include Bewick's wren, golden-winged warbler (possible breeding within watershed), prairie warbler (possible breeding within watershed), and whip-poor-will (probable breeding within watershed), that all require early successional shrub habitat. Cerulean warbler, worm-eating warbler, Louisiana water thrush, and wood thrush (probable breeding within watershed) all require a more mature deciduous forest habitat. Grassland areas are required for Henslow's sparrow, whereas the Black-throated blue warbler (confirmed breeding within watershed) and blackburnian warbler (possible breeding) require a northern hardwood/spruce-fir forest. A cursory review of the *WV Breeding Bird Atlas* (Buckelew, Jr. and Hall, 1994) shows that some of these birds do breed within the Upper Tygart Valley watershed.

Recent information is beginning to note that mid-successional stands do not provide optimum conditions for many neotropical migratory birds. Because of past large scale clear-cutting, these stands may not provide the structural diversity needed to provide optimum nesting and foraging cover. Some avian experts are recommending forestry practices which restore vegetation structural layers to stands where mid and understory cover is lacking (Hunter, 1990). The PIF physiographic area summarizes conservation recommendations which include ensuring adequate tree-species composition and structural diversity where needed.

Age class diversity is present; however limited representation of the youngest and oldest age classes is evident (see Table 3.8). The oldest forested stand in this watershed has a year of origin in 1846. The youngest early successional stand in this watershed has a year of origin in 1996. Forest Plan 6.1 MP standards and guidelines suggest a desired future condition of 5 percent of National Forest System land in old growth. Although there are currently no lands allocated to "old growth", approximately 78 percent of National Forest System land in this watershed is considered to potentially exhibit some old growth characteristics or is presently available as future mature stands.

Table 3.8 - Age Class Distribution

Existing age class distribution within Upper Tygart Valley Watershed	Age Class (in years)	Acres	% NFS Land
Early successional	0-15	137	0.8 %
Mid-successional	16-30	356	2.1 %
Mid/late successional	31-60	578	3.5%
Late successional	61-75	2,614	15.8 %
Mature	75-90	6,136	37 %
May exhibit old growth characteristics	91-105	3,787	22.8 %
May exhibit old growth characteristics	106 +	2,727	16.5 %
Permanent open/brushy	0	247	1.5 %

Early successional forest habitat (grass/shrub/seedling stages, 0-15 years old) importance is well documented. Only 137 acres of early successional habitat is found on National Forest System land in this watershed. This habitat's physical properties result in distinct microclimates that are rare or absent in closed-canopy forests and including intense light, high temperatures, and low soil moisture (Litvaitis 1993). However, according to Litvaitis, 1993 some wildlife ecologists may be reluctant to advance the needs of early-successional species because it hints at "game management" or seems a contradiction to express concern over forest fragmentation and still endorse the application of even-aged management to enhance wildlife diversity. Early successional stands are regenerating areas covered with tree seedlings/saplings and herbaceous growth. These stands should include older "wildlife" leave trees throughout. Species that use early successional forests and would be expected to inhabit areas within Upper Tygart Valley watershed include: Eastern American toad, Fowler's toad, common snapping turtle, spotted turtle, wood turtle, box turtle, garter snake, eastern hognose snake, black racer, green snake, black rat snake, milk snake, coopers hawk, red-shouldered hawk, red-tailed hawk, ruffed grouse, turkey, mourning dove, screech owl, great horned owl, hummingbird, willow flycatcher, loggerhead shrike, Carolina wren, eastern bluebird, hermit thrush, mockingbird, brown thrasher, cedar waxwing, blue-winged warbler, golden-winged warbler, field sparrow, fox sparrow, song sparrow, gold finch, northern short-tailed shrew, least shrew, hairy-tailed mole, eastern mole, little brown bat, northern long-eared bat, small-footed bat, big brown bat, eastern cottontail, eastern chipmunk, deer mouse, white-footed mouse, red-backed vole, meadow vole, woodland vole, meadow jumping mouse, red fox, black bear, skunk, and white-tailed deer (DeGraaf and Yamasaki 2001).

Mid – Mid/late successional habitat (sapling/pole stage, 16-60 years old) is currently found on approximately 934 acres of the Upper Tygart Valley watershed. These stands are generally dominated by four to ten inches dbh tree species. These stands tend to have a high stem per acre count. All stems are about the same height and there is little understory or herbaceous growth due to shading. Young trees are competing for sunlight and stems that cannot grow fast enough start to die off. Vegetative diversity begins to decline (as compared to regenerated stands) due to rapid growth and herbaceous/shrub layer declines. Wildlife species using this environment include: Alder Flycatcher, Eastern kingbird, horned lark, eastern bluebird, Brown thrasher, loggerhead shrike, white-eyed vireo, yellow warbler, chestnut-sided warbler, Indigo bunting, New England cottontail, Meadow jumping mouse and white-tailed deer (DeGraaf and Yamasaki 2001).

Mature forest habitat (late successional, 61-90 years old) includes mature hardwoods, conifer and mixed hardwood/conifer communities. Competition has sorted trees into dominant, co-dominant, suppressed and understory stems. Shade tolerant trees start to become part of the understory in the early part of this stage. Gaps begin to form as dominant trees die and the understory is released. Saw-timber forest conditions

predominate throughout the project area. Approximately 8,750 acres of Upper Tygart Valley watershed falls within this age class. Wildlife species expected in this age class include: pileated woodpecker, eastern phoebe, gray squirrel and southern flying squirrel, white-tailed deer, black bear.

Older forest habitat (91+ years old) is found on approximately 6,514 acres of National Forest System land in this watershed. The Forest Plan provides general old growth guidelines for each management area. In MP 6.1 lands, the desired future condition is for old growth to be provided on 5 percent of MNF land. While Forest Plan guidelines provide general direction as to acres of old growth, current literature provides more comprehensive definition of old growth features. Forest Plan suggests designating oldest age class stands. However, we now recognize that age is only one criterion, and true "old growth" contains values that can only be developed over time. We now consider older age stands as late-successional forest or "potential" old growth. Although 12,650 acres of Upper Tygart Valley watershed provides the older forest conditions, these forested stands are second or third-growth forest. There is presently no true old growth within the watershed area. Wildlife species expected to inhabit this "oldest growth" ecosystem include: Acadian flycatcher, black bear, turkey, bobcat and pileated woodpecker.

The table below displays existing forest types found within Tygart Valley watershed area. Forest types consisting of one percent or less are not included. Several forest types have been grouped together. McShea and Healy 2002, caution that using only forest cover types is a poor predictor of wildlife species distributions, because most species occur in many forest cover types and use stands of more than one age or tree size (DeGraaf et.al. 1992).

Table 3.9 - Forest Type Distribution

Forest Type	Forest type description	Total watershed acres
13	Red spruce-balsam fir, Norway spruce	375
52	Chestnut oak	562
55	Northern red oak	229
56	Yellow poplar-northern red oak-white oak	297
59	Mixed oak	4,435
81	Northern Hardwoods	
	Sugar maple-beech-yellow birch	4,083
82	Sugar maple-basswood	178
87	S.maple-beech-y.birch-red spruce	1,100
89	Mixed hardwoods	4,396
99	Open	190

Habitat within this watershed is varied and therefore contains habitat for a wide array of wildlife. Three hundred-seventy-five (375) acres have been typed as spruce stands within Upper Tygart Valley watershed. An additional 1100 acres of spruce mixed with hardwoods is found within stands typed as sugar maple/beech/yellow birch/red spruce. The high elevation spruce provides habitat for unique species such as red-breasted nuthatch, saw- whet owl, snowshoe hare, and West Virginia northern flying squirrels, golden-crowned kinglet, and blackburnian warbler. Other species that utilize spruce forest habitat include: red-back salamander, wood turtle, eastern garter snake, sharp-shinned hawk, northern goshawk, ruffed grouse, downy

woodpecker, black-capped chickadee, pine grosbeak, evening grosbeak, water shrew, smoky shrew, hairy-tailed mole, red squirrel, northern flying squirrel, deer mouse, white-footed mouse, southern red-backed vole, rock vole, red fox, bobcat and white-tailed deer (DeGraaf and Yamasaki 2001).

Oaks (forest types 52, 55, 59) have been a major eastern forest component for over 6,000 years. It has been estimated that 49 species of birds and mammals utilize oak mast in the East (Miller and Lamb 1985). Deer, turkey, bear, ruffed grouse, and squirrels rely heavily on acorns to satisfy energy requirements. Other mammals like blue jays and rodents are critical for acorn dispersal. Species expected in this habitat include: wood turtle, box turtle, garter snake, black racer, coopers hawk, screech owl, pileated woodpecker, blue jay, black-capped chickadee, tufted titmouse, junco, masked shrew, short-tailed shrew, hairy-tailed mole, chipmunk, grey squirrel, southern flying squirrel, deer mouse, white-footed mouse, red-backed vole, fox, bobcat, black bear and deer.

Northern hardwoods (forest types 81, 82, 87) include sugar maple-beech-yellow birch; sugar maple-basswood, and sugar maple-beech-yellow birch-red spruce forest types. Species utilizing this habitat include: wood turtle, eastern box turtle, eastern garter snake, northern goshawk, turkey, eastern screech owl, downy woodpecker, hairy woodpecker, pileated woodpecker, blue jay, black-capped chickadee, white-breasted nuthatch, red-eyed vireo, ovenbird, junco, shrews, southern flying squirrel, deer mouse, red-backed vole, rock vole, jumping mouse, fox, skunk, bobcat and deer.

Cove hardwoods (forest type 56) contain 297 acres of yellow poplar-northern red oak-white oak stands. This forest type has been separated out from the mixed oak group as these areas tend to be moist areas as compared to more xeric conditions where mixed oak types are found. Species expected to occur in this area include those listed in the mixed oak group.

Mixed hardwoods (forest type 89) makes up the majority of habitat within Upper Tygart Valley watershed. Specifically 4,396 acres have been typed as mixed hardwood. Species expected in this habitat include: spotted salamander, mountain dusky salamander, red-back salamander, slimy salamander, northern spring salamander, wood turtle, eastern box turtle, northern red-bellied snake, eastern garter snake, black racer, sharp-shinned hawk, cooper's hawk, northern goshawk, red-shouldered hawk, turkey, eastern screech owl, great horned owl, barred owl, northern saw-whet owl, yellow-bellied sapsucker, downy woodpecker, hairy woodpecker, pileated woodpecker, blue jay, black-capped chickadee, tufted titmouse, red-breasted nuthatch, white-breasted nuthatch, brown creeper, wood thrush, red-eyed vireo, black-throated blue warbler, black-throated green warbler, ovenbird, scarlet tanager, white-throated sparrow, dark-eyed junco, opossum, masked shrew, water shrew, smoky shrew, long-tailed shrew, pygmy shrew, northern short-tailed shrew, hairy-tailed mole, little brown bat, Indiana bat, eastern pipistrelle, big brown bat, southern flying squirrel, gray squirrel, beaver, deer mouse, white-footed mouse, southern red-backed vole, rock vole, woodland vole, woodland jumping mouse, red fox, black bear, raccoon, skunk, bobcat and white-tailed deer.

Non-Forest (99) - One hundred ninety National Forest System acres have been identified as open. Openings, or non-forested habitat, are an important wildlife habitat component. Upland and wetland non-forest types provide basic habitats for distinct groups of species. These non-forest types are seasonally important wildlife elements for species that also use forested habitat (such as brood habitat for ruffed grouse and turkey and spring and fall forage for deer and black bear). Although regenerating timber (less than ten years of age) serves as temporary openings, wildlife communities associated with upland non-forested habitat are different from those found in regenerated timber stands. The difference is largely due to the amount of dense, continuous herbaceous cover, which lasts longer in permanent openings than in regenerating stands. Size of

openings is also a consideration. Wildlife that use only non-forested habitats tend to be species that utilize primarily larger openings (five to ten acres), while species that utilize forest and non-forest types are found using smaller-sized openings. Species using this habitat include: eastern bog turtle, wood turtle, garter snake, hognose snake, black racer, green snake, American kestrel, morning dove, horned lark, American crow, eastern bluebird, American robin, migrant loggerhead shrike, savannah sparrow, song sparrow, eastern meadowlark, masked shrew, short-tailed shrew, eastern mole, eastern cottontail, woodcock, white-footed mouse, meadow vole, woodland vole, house mouse, fox, black bear, skunk, and deer.

Threatened/Endangered/Sensitive Fauna

Threatened and endangered species that are known to occur in this watershed include WV Northern flying squirrel, Indiana bat, Virginia big-eared bat, Cheat Mountain salamander, and Running buffalo clover. There is also potential habitat for the bald eagle and small whorled pogonia.

West Virginia Northern Flying Squirrel (WVNFS) – The preferred habitat of the WVNFS in the southern Appalachians is conifer/northern hardwood ecotones or mosaics consisting of red spruce and fir associated with beech, yellow birch, sugar maple/red maple, hemlock and black cherry (USFWS NFS Recovery Plan, 1990). Until the late 19th century, spruce forests covered more than 200,000 hectares of the state, but these forests were almost completely eliminated by logging from 1880 to 1920 (Millspaugh 1891; Clarkson 1964). Records from 1983 indicate that at that time spruce forests occupied about 24,000 hectares in the state (Stephenson and Clovis 1983). Recent studies indicate that red spruce has been declining since the 1960s. The exact cause is unknown, although acid deposition is being considered as a contributing factor (Stephenson 1993).

To support the aims of the Northern Flying Squirrel Recovery Plan (USFWS NFS Recovery Plan 1990), efforts should be made where possible in this watershed to manage marginally suitable habitat to enhance its conifer content. Because little research has been done on the effects of silvicultural management on the WVNFS, opportunity exists in suitable habitat to study the effects of management (i.e., releasing conifer, or enhancing yellow birch).

Although the vast majority of the watershed consists of mixed hardwood/oak forests, a small spruce component exists at the higher elevations along the eastern side of the watershed along with a sugar maple/beech/yellow birch/red spruce forest type. No trapping for squirrels has been accomplished for this specific assessment. However nest box surveys completed in 1990, 1992, 1993, 1996, 1997, 1999, 2000, 2001 and 2002 have resulted in 41 captures within 11 boxes (7 boxes on Forest Service land, 4 boxes on other land). Monitoring is an important West Virginia northern flying squirrel recovery plan objective (USFWS, 1990). Forest Plan Amendment for Threatened and Endangered species identifies standards and guidelines that will be followed for this species. Overall, the Upper Tygart Valley watershed does not provide a large quantity of high quality WVNFS habitat.

Indiana bat (IB) – is distributed throughout the eastern U.S. from Oklahoma east to Vermont and south to northwestern Florida (Romme et al. 1995). During winter, IB restricts themselves to karst areas of east-central U.S. Hibernacula monitoring shows IB populations are decreasing in portions of their core range (USFWS 1996) but not in WV, where estimated populations have been increasing since the early 1980s (Endangered Species Federal Assistance Performance Reports, WVDNR 1981-99). Most significant caves are gated or fenced, which has protected IB populations and likely has been responsible for their increases (Wallace 1999). In the last decade, WV has seen a 45 percent increase in the number of hibernating IB

(Wallace 1999) with the total IB population in the state at approximately 10,658 individuals (Stihler et. al 2000). This represents three percent of the entire hibernating IB population range-wide. IB occurs in at least one cave within the Upper Tygart Valley watershed. Approximately 26 West Virginia caves provide adequate IB winter hibernacula. Five of those caves are on the MNF.

This watershed contains important limestone formations and associated cave systems. There are eight caves that serve as Indiana bat hibernacula in or within the five-mile radius of Upper Tygart Valley watershed boundary. The five-mile radius drawn around each of these eight caves almost totally encompasses the watershed. This distance was chosen as Indiana bats have been noted to use habitat as far as five miles from a hibernaculum's as swarming areas before returning to the hibernaculum's for winter. It is not uncommon for some males to remain near the hibernacula during the summer (Stihler 1996). Because of this, felling trees for timber harvesting within five miles from a hibernacula is prohibited from April 1 through November 15 (Biological Assessment for the Monongahela National Forest**).**

Indiana bats are known to forage and roost in upland areas. Five areas within the watershed have been mist-netted. One hundred twenty-five bats (eight species) were captured. Two adult male sodalis were captured. As of summer 2003, no confirmed Indiana bat maternity colonies have been found on the MNF. Potential habitat exists within this project area. Stands of mixed hardwoods greater than 70 years old could provide maternity and foraging habitat.

Data gaps regarding Indiana bats are numerous. Additional monitoring has been identified by the USFWS and documented in the Biological Opinion for the Monongahela National Forest and T&E Plan Amendment.

Virginia big-eared bat (VBEB) – is a geographically isolated and sporadically distributed cave obligate species. While it is known from karst areas in Kentucky, eastern WV, western Virginia, and western North Carolina (Clark and Lee 1987), WV contains the largest VBEB population, particularly in Pendleton County (Barbour and Davis 1969; Stihler et. al 2000). "Critical habitat" for the VBEB is based on the precise physical structure, temperature, and humidity conditions required for its continued survival.

West Virginia's Cave Mountain Cave, Hellhole, Hoffman School Cave, Sinnit Cave, and Cave Hollow/Arbogast Cave are designated as "Critical Habitat" for this species based on the precise physical structure, temperature, and humidity conditions required for its continued survival, as well as the significant number of VBEB that occur there. In most years, approximately 28 West Virginia caves provide adequate VBEB habitat; 6 of those caves are on the MNF and harbor approximately 30 percent of all *C. virginianus* in West Virginia during the summer. In winter, these caves contain approximately seven percent of all *C. virginianus* in West Virginia. There is one cave within the watershed which Virginia big-eared bats (VBEB) have been documented. There were no VBEB captured during summer mist net projects.

At least thirteen of the fifteen VBEB caves in West Virginia are gated, fenced or signed as closed; several having agreements with private landowners to deter people from disturbing the bats during critical times of the year. Currently, hibernating bats in West Virginia total 7,578. The VBEB population in WV and across its range has been increasing. Based on winter counts, there are approximately 20,000 VBEB in WV, North Carolina, Kentucky and Virginia.

Cheat Mountain salamander (CMS) – is a relict species of 59 disjunct and genetically isolated populations (Pauley and Pauley 1997; Kramer et al. 1993). It is geographically restricted to high elevation forests containing a red spruce component (Highton 1971) and mixed deciduous forests with a *Bizzania*-dominated

forest floor (Pauley and Pauley 1997). The highest elevation at which CMS has been recorded is 4,860 feet above sea level, on top of Spruce Knob (Tom Pauley, personal communication). Their range is a 700 square mile area exclusively within WV, with 88.2 percent of the known populations on the MNF. Seventy-five percent of the known populations have less than ten individuals (Pauley 1991). Historically, the range of CMS was likely more extensive than it is today. In colonial times, the first settlers began converting this habitat to other uses almost immediately in the Virginia territory. By 1920, natural events and extensive logging eliminated over 93 percent of the original spruce acreage (Clarkson 1964).

Surveys specifically to identify Cheat Mountain salamander presence and population boundaries have been completed across the Forest and areas specific to the Upper Tygart Valley watershed. An entire Forest survey has not been completed due to budget constraints. This information is critical to meet Recovery Plan objectives. Because CMS is a habitat specialist, caution must be used when applying specific population locations to other reptile and amphibian species. Cheat Mountain salamanders do not compete well with other more common and widespread species. Their habitats are much more specialized and they are more susceptible to disturbance and less likely to repopulate an area than more common amphibian species that are more widespread and use more general habitats.

Cheat Mountain salamander population delineations occur through efforts by Dr. Tom Pauley, Marshal University. Establishing population boundaries are difficult, time consuming and extremely costly to determine and monitor, however, this must be done to meet Recovery Plan objectives. A more concerted effort must be established on the Forest to meet Recovery Plan objectives for Cheat Mountain salamanders. There are two known CMS locations just outside the watershed's southeast boundary in what Dr. Pauley considers high probability habitat. These sites still require actual population delineation. Twenty additional areas along the eastern boundary have been surveyed, but no additional CMS have been located.

Bald eagle – There are known bald eagle nests within the state of West Virginia and on the MNF. Because the Upper Tygart Valley watershed does not contain any large lakes or rivers to provide sufficient long-term foraging opportunities, it would not provide optimum habitat for summer breeding use by bald eagles. However, migratory routes traverse areas of the MNF. The higher ridges of this watershed could provide stopping points for eagles as they migrate across this area. Maintaining snags and forested areas along ridge tops would maintain the potential for use as migration stopping points.

Sensitive Species

Species on the Region 9 sensitive species list that have confirmed occurrence within the project area include:

Eastern Small-footed bat (*Myotis leibii*)- Two adult female small-footed bats have been captured during summer mist-netting within the watershed.

Organ Cavesnail *(Fontigens tartarea)* - is found in Simmons/Mingo cave within the watershed, but located on private land. This cave is also an Indiana bat hibernacula.

Southern Rock Vole (SRV) *(Microtus chrotorrhinus carolinensis),* – Southern rock voles inhabit boulder fields, talus slopes and other rocky areas in a variety of forest types, including red spruce and deciduous forests. Another seemingly important habitat feature is water, either as a surface or subsurface stream. The presence of mosses, forbs, and other ground-cover plants also determines the presence or absence of this species (Kirkland and Jannett 1982). Forest age where SRV are found ranges from recent clearcuts to uncut

forests (Kirkland and Jannett 1982, Whitaker and Hamilton 1998, Wilson and Ruff 1999). A single known location is found on the eastern perimeter of the watershed on Forest Service land. There are several areas of potential habitat for SRV on this portion of the MNF including rock walls and boulder fields, although there are no documented occurrence records of this species.

Allegheny Woodrat (AWR) *(Neotoma magister)* – Historically, the AWR ranged from southeastern NY to as far south as TN, although populations in NY are now considered extirpated. The current range extends from PA and NJ southward along the Appalachian Mountains to northern AL and GA (Hicks 1989, Balcom and Yahner 1996, Whitaker and Hamilton 1998, Wilson and Ruff 1999).

Percent rock cover and aspect of an area often determines the distribution of AWR. Steep, rocky habitat is preferred by AWR as it provides an abundance of crevices and fissures for nest site locations that are well-concealed from predators (Balcom and Yahner 1996, Whitaker and Hamilton 1998). Preferred rock characteristics include rock and boulder fields with an abundance of large, deep crevices or rock outcrops where crevices are minimal but deep. Sizes of occupied areas vary, but it appears that two or more acres of contiguous rocks and boulders is optimal habitat (Hassinger and Butchkoski 1995). These rodents are also known to occupy caves (Whitaker and Hamilton 1998).

Three known site are located within the watershed. Two sites are within 0.2 miles of Big Run Cave and Big Run Cave #2. The third is located on private land. The decline of oak species in the Appalachians has been an important factor in the decline of the AWR. Widespread gypsy moth defoliation of oaks has reduced AWR winter food sources in many areas. In addition, changes in forest composition from an oak-dominated landscape to a forest dominated by later-successional species reduces quality habitat for AWR, although there is some evidence that AWR may substitute black cherry and fire cherry (*Prunus pensylvanica*) for acorns (Balcom and Yahner 1996, Castleberry 2000a).

Allegheny woodrat colonies are often isolated and disjunct, and therefore are highly susceptible to fragmentation. Although there is no evidence that low levels of human activity near nest sites and/or timber harvesting are directly responsible for the decline of this species, forest fragmentation as a result of agricultural activities and residential development may indirectly cause AWR populations to decline as a result of increased predator population, such as the great horned owl. Raccoon populations also increase in these areas, which in turn increase exposure to the raccoon roundworm (*Baylisascaris procyonis*), a fatal parasite to AWR (Balcom and Yahner 1996, Mengak 1996).

A Cave Beetle – *(Pseudanophthalmus hypertrichosis)* is found in Crawford #1 cave within the watershed, but located on private land.

Holsinger's Valley cave isopod – A single occurrence is found on private land in the SE portion of the watershed in Devils Kitchen cave.

Green salamander *(Aenides aeneus)* - A single occurrence is recorded on the western perimeter of the watershed boundary.

White alumroot *(Heuchera alba)* **–** Two populations are found within the watershed on Forest Service land.

Butternut *(Juglans cinerea)* - A single occurrence is recorded on Forest Service land within the watershed boundary.

Other sensitive species that may occur within this watershed based on available habitat include Appalachian water shrew (*Sorex palustris punctulatus*), northern goshawk (*Accipiter gentilis*), Loggerhead shrike (*Lanius ludovicianus migrans*), Timber rattlesnake (*Crotalus horridus),* Hellbender (*Cryptobranchus alleghaniensis*). Goshawk surveys using taped calls were done in this watershed during June/July 2000, 2001 and 2002. No goshawks were observed in response to these calls.

Specific sensitive species surveys for species other than the Goshawk, and project specific botany surveys have not been done within the Watershed area.

Management Indicator & Emphasized Species

The Monongahela National Forest Plan lists Management Indicator Species (MIS) that were selected to represent important game, T&E, unique interest, and species to represent other habitats. The objects are to maintain viable population levels (for TES), or to reach desired population objectives for other species (FP L-1). Population objectives found in the Forest Plan (L-4), are extremely high. Conversations with WVDNR personnel affirm this as well. It would be unrealistic to believe that any area could support populations as large as what is written in the Forest Plan.

Virginia big-eared bat – is known to be present in caves within the Upper Tygart Valley watershed. There are also summer and winter colonies occupying caves within six miles outside the watershed boundary. The specific population objective for this species is to meet Recovery Plan objectives.

Indiana bat – are present in caves that are serving as hibernacula. The caves are located on private land and National Forest System land, either inside the watershed boundary or within five miles outside the boundary. The specific population objective for this species is to meet Recovery Plan objectives.

Cheat Mountain salamander – is known to be present in the watershed. Surveys have been conducted at various locations throughout the watershed. Population objectives for this species are to meet Recovery Plan standards that include ten salamanders per acre in occupied range with no loss of isolated populations.

Wild (native brook) trout – were collected in most of the sub-watershed streams. Population objectives in the 1986 Forest Plan of 250 – 2500 trout/acre are not realistic, based on available spawning habitat (Mike Shingleton, WVDNR, personal comm.). Additional information can be found in the watershed assessment aquatic section.

Black bear – are present within this watershed and their numbers are increasing statewide. Good habitat is provided by vegetative diversity of oak, beech, rhododendron, and mountain laurel cover. Estimates of black bear populations ranged from 500 in the early 1970s to approximately 4,000 by 1998. According to the WV's bear populations were computed to be approximately 2,900 bears in the mountainous regions and 1,100 in the remaining areas. For the first 15 years of bear hunting (from 1964 to 1978) only 912 bears were harvested (about 60/year). In 1989 hunters harvested 510 bears. In 2002 hunters harvested an annual record of 1,362 bears in West Virginia. The bear harvest in Randolph County in 2002 was 191. Statewide, 82 bears died in vehicle collisions. (WVDNR 2002)

The Upper Tygart Valley watershed lies almost entirely within Randolph County, and is found in the WVDNR Cheat Wildlife Management Area. It is difficult to determine population estimates within a

watershed boundary, as bear populations and yearly kills are identified on a county basis. This makes it especially hard to compare existing populations with the population objectives in the Forest Plan as those are based on vegetative types and Forest Plan Management Areas. However, with bear harvests continuing to increase almost yearly, populations appear to be stable or increasing.

Wild turkey – populations appear to remain fairly steady in West Virginia since 1992 after steady increases since the 1960s, 70s, and 80s. Stocking with wild-trapped turkeys has occurred throughout the state with the 1997-estimated total turkey population to be around 140,000. This increase in wild turkey populations has paralleled not only the WVDNR's wild turkey restoration program, but has correlated with the increased maturity of the state's forests. Wild turkey habitat needs to include a relatively mature mast producing forest (oaks, hickories, beech) and brooding areas (grassy openings).

The Upper Tygart Valley watershed encompasses approximately 151 square miles. Population objectives in this area suggest 31.7 turkeys per square mile are optimal. According to Shawn Head, WVDNR, this objective is too high and not realistic. A more reasonable objective would be where turkey populations within the watershed reach approximately 2000 individuals (or 13.2 turkeys/square mile). Wildlife personnel on the National Forest continue to conduct habitat improvements and maintenance that benefit wild turkey.

Fewer wild turkeys were harvested state-wide in 2002 (16,193) compared to last year (21,380). The lower number is attributed to the cooler wet weather. In Randolph County 389 wild turkeys were harvested including 2 in Becky's Creek Wildlife Management Area and 9 in Kumbrabow State Forest (WVDNR 2002).

White-tailed deer – populations have been increasing steadily in West Virginia since the late 1960s. Deer is the most valuable big game species in WV in terms of recreational and economic importance. Harvest regulations, intense management, reintroduction and environmental changes have resulted in an increase in deer numbers. Deer populations are monitored annually through the WVDNR annual harvest reports. Hunters harvested an annual record of 255,356 deer in 2002 state-wide. For the number of deer harvested by hunters alone represents one deer killed for every 57 acres of available habitat in West Virginia. Another 27,069 deer were killed by other causes (19,483 by vehicle collisions) in 2002. Within Randolph County 9,069 deer were harvested in 2002 including 8 in Becky's Creek Wildlife Management Area, 39 in Huttonsville State Farm Wildlife Management Area and 73 in Kumbrabow State Forest (WVDNR 2002).

Although deer populations continue to increase, there is a natural limit to the number of deer the land can support. When natural limits are exceeded over time, a long-term reduction in the amount and diversity of vegetation occurs since deer favor certain plants for browse and avoid other plants. Generally, plant diversity, height growth of young woody stems, and browse abundance begins to decrease at about 25 deer/square mile. At 40 deer/square mile a browse line becomes apparent where only non-preferred browse species are growing within five feet above the forest floor. Recovery of vegetation diversity occurs at less than 12 deer/square mile. However, once browse resilient species become established, they may minimize or inhibit the growth of less browse resilient plants that previously occupied the site (Horsley, Stout, and DeCalesta 2003). Based on this research and past experience, it is apparent the objective of 50.5 deer/square mile in the 1986 Forest Plan in mixed hardwood and oak/hickory forests in 6.1 management areas is too high. At 50.5 deer/square mile there would be a drastic decrease in vegetation diversity and abundance.

Gray squirrels – are the most popular game species in WV. Annual harvest may approach two million. Annual fluctuations in squirrel populations are normal and occur primarily in response to the abundance of

hard mast in the preceding year. Predators seem to have little impact on overall squirrel populations as well as sport hunting, although intensive hunting may reduce squirrel abundance in localize areas. Good habitat, such as oak/hickory forests at peak mast producing age (generally from 40 to 125 years old, depending on the species), is the most important factor in squirrel abundance. Red, black and scarlet oak are more reliable mast producers than white or chestnut oak and these species should be favored if squirrel production is desired.

Varying (snowshoe) hare – In WV, the snowshoe hare inhabits dense thickets of rhododendron and other low-growing shrubs with numerous small openings close to cover. They feed on beech, birch, blueberry, brambles, grasses, cranberry, maple, serviceberry, and rhododendron. Because a diversity of vegetation in mountains provides a variety of woody browse and cover, in sharp contrast to the extensive uniform vegetation of aspen, alder and spruce in its northern range, the vegetation-dependent snowshoe hare does not exhibit the strong cyclic fluctuations of its northern relatives (Stephenson 1993). It is not known if there are any snowshoe hare in the Upper Tygart Valley watershed.

Neotropical Migratory Birds

Partners in Flight (PIF) have developed priority bird species and habitats for physiographic areas across the U.S. The MNF lies in the Mid-Atlantic Ridge and Valley (Physiographic area 12) (Pashley, D.N. et al, 2000). Table 3.10 shows the priority birds and habitats in this region, and their probability of occurrence in this watershed according to *WV Breeding Bird Atlas* data (Buckelew, Jr. and Hall 1994).

Table 3.10 - Neotropical Migratory Bird Occurrence Probability

Habitat and Species	**Probability of occurrence in watershed**
Early successional habitat	
Bewick's wren	Rare in the state; no breeding observations in watershed; has been recorded during migration
Golden-winged warbler	Present, but not abundant, in lower elevations
Prairie warbler	Present, but not abundant, in lower elevations
Whippoorwill	Although present in state, few to no observations in this watershed
Mature deciduous forest	
Cerulean warbler	Present, but uncommon above 2,000'
Worm-eating warbler	Present, but not common
Louisana waterthrush	Present, but not common
Wood thrush	Common to abundant in deciduous forests
Northern hardwood /spruce-fir forests	
Black-throated blue warbler	Common in the higher spruce elevations
Blackburnian warbler	Common in the higher spruce elevations
Grassland	
Henslow's sparrow	No point counts have been done specifically in grassland areas on district; rare in state.

Human Uses

Reference Condition

Heritage Resources

The conditions described in the terrestrial reference condition for this area for the distant past is integral to understanding the presence of people on the landscape for the last several thousand years. Studies of pollen and spore analyses from the region and comparative data (e.g., Carbone 1976; Davis 1983; Wilkins 1977), indicate that a southward displacement of boreal floral and faunal species followed the terminal glacial retreat. Pockets of tundra vegetation, dominated by spruce, fir and pine, extended from the north into the uplands region of the Appalachian range between 25,000 and 15,000 BP (before present). The transition to more modern flora begins between 12,500 and 10,000 with an increase in deciduous forest, with species including oak and ironwood present. This period coincided with the first probable human use of the region. This epoch also saw the extinction of many faunal species including elephants, camel, mastodon, giant bison, giant peccary, giant beaver, ground sloth, and woodland musk ox. By 10,000 the transition to a mixed coniferous-deciduous forest had begun.

By 7,500 BP mixed hardwood forests are present on the Allegheny Plateau, with the expansion of birch, oak and hickory communities. Continued warming trends led to mixed hardwood forests at higher elevations. Around 5,000 BP spruce forests experienced a resurgence in Pennsylvania and West Virginia, probably indicating the spread of diverse open forest canopies and bog settings (i.e., the growth of Picea rubens). Modern climatic conditions were probably in place by around 3000 BP, although various peaks-and-valleys in temperature and moisture regimes continued to the present. This affected both the vegetation mixes and fish/wildlife species and, by direct extension, subsistence patterns for people.

Human use of the landscape during the PaleoIndian and Early/Middle Archaic sequences (ca. 11,000-6,000 BP) was largely restricted to hunting/gathering/fishing, and establishment of domestic sites. The bedrock types in the study area may have encouraged quarrying for raw material to make stone tools. The presence of numerous potential campsites in the form of rockshelters also may have encouraged human use of the landscape at this time.

The implications of the early prehistoric period on the reference condition of the watershed are minimal. Some modification of plant communities occurred through harvest and selective protection; some animal populations were controlled through hunting and trapping; and the use of fire as a habitat management tool may have occurred. However, by and large, human populations are perceived to have been too small during the early periods (Paleo-Indian and Early/Middle Archaic) to cause significant effects on the environment.

In contrast, Late Archaic and Woodland Period societies (ca. 6,000 BP to 1600+ AD, including early European colonization/contact) had increasingly noticeable impacts on the environment. Larger populations, new technologies, an evolving subsistence strategy, and associated increases in the size and duration of occupation of villages, all led to deeper and more widespread human impacts. The major activities that changed the environment were: the intentional encouragement and protection of plant communities; burning to open up the understory and enhance game habitat, targeting berry and mast species, and contributing to an oak presence; the adoption of horticulture and agriculture over the last 2,000 years, requiring cleared gardens

and fields, many near streams and rivers; and biodegradation of local environments associated with, for example, long-term village locations.

In summary, subsistence activities and residential sites would have had an effect on the health and diversity of the forest community, size and behavior of wildlife species, and fragmentation of the forest. It also increased sedimentation rates in the streams near villages. The Native American population was displaced through disease and war, starting in the 17th century. The effect of smallpox on the Native American was enormous: by some estimates more than half the pre-European population was killed by smallpox before they had even laid their eyes upon a wagon. Thus, the pre-Contact patterns of their lifestyle are now known only through archaeology, oral history and a handful of early settlers' or explorers' accounts.

Current Condition

Recreation

Although there are no Forest Service managed developed recreation facilities, the Kumbrabow State Forest and private operators do provide campgrounds, picnic areas, and cabin rentals within the assessment area. Developed recreation opportunities in Kumbrabow State Forest include camping, cabin rental, picnic and day use facilities. Mill Creek provides an outstanding brook trout fishing opportunity. This forest also provides excellent opportunities to hunt deer, bear, wild turkey, grouse, raccoon, and gray squirrels. The area receives an estimated 35,000 recreation days annually.

Dispersed recreation use within the Upper Tygart Valley watershed is generally low with the exception of hunting and fishing which is moderate. . Primary activities include hunting and fishing with most public access occurring along FR-92 and the County road in lower Mill Creek. Due to the intermingled ownership patterns within the area, access from private lands is probably quite common especially during hunting season. Although prohibited, ATV use within the watershed assessment area is quite common. Two specific areas where ATV use is occurring is; (1) off of County Road 39/1 on the east side of the trail and (2) the general area of County Road 39/1 and Shavers Run.

A majority of the watershed assessment area is either in private land or Forest Service System lands that have a low scenery concern level. There is intermingled foreground and middle-ground (moderate to high concern levels) that should be managed to protect their scenic attractiveness. The scattered ownership patterns within the assessment area substantially reduce the opportunities for visitors to sense an undisturbed expanse of forested land.

Travelers along U.S. 219 see the terraces and foothills to the east as the confining transition between the valley floor and the ridgeline of Cheat Mountain. Views within this assessment area are all middle-ground views from U.S. 219 and thus details are not evident but the hills are seen through general vegetative pattern and color contrasts. The vegetation is predominately hardwood, with no visually important conifer component. The valley is open farmland interspersed with hardwood woodlots and riparian vegetation forming an attractive contrast to the even-textured forested hillsides. Rare openings where farm fields and pastures intrude upslope onto the hills are important and attractive visual elements. A few previously harvested areas mimic these hillside openings. Rock and water forms are not visually important within this assessment area, though glimpses of the Tygart Valley River are a scenic attraction in the valley along U.S. 219. The valley contains a wide variety of homes, farms, pastures, and businesses. The atmosphere here is more urban than most other areas of the Monongahela National Forest. The level of activity makes it

somewhat easier to mimic agricultural and other uses in the layout of timber harvest unit, but it also means that activities on the hillsides are visible to a greater number of residents and visitors. Most of the Upper Tygart Valley area is hidden from view of residents and travelers alike. Most of the visually sensitive areas are the ridgelines, where the creation of a gap or notch could cause disruption of the scene and draw negative attention. Also important are the steeper hillsides where the construction of skid trails could bring color and line contrast, again drawing the attention of the viewing public.

A semi-primitive non-motorized Recreation Opportunity Spectrum (ROS) setting is prescribed for this management area. The Scenery Management System (SMS) Objectives are designed to blend with the natural character of the landscape (meet ROS objectives) and are identified in the chart below. Although most of the area is in a low visual concern area there are pockets of distinctive and typical scenic attractiveness with moderate to high scenic integrity levels. These areas should receive special consideration during road construction and vegetative management practices.

Table 3.11 - Scenery Management System Matrix (MA-6.1)

Distance Zone (Seen Area)	**Preservation**	**Fore-Ground**	**Fore-Ground**	**Middle-Ground**	**Middle-Ground**	**Back Ground**	
Concern Level	1 High	1 High	2 Mod	1 High	2 Mod	1 High	3Low
Scenic Attractiveness							
			Scenic	**Integrity**			
A - Distinctive	VH	VH	H	M	M	M	M
B - Typical	VH	H	M	M	L	L	L
C -Indistinctive	VH	M	L	L	VL	VL	VL

Scenic Attractiveness

Distinctive -Landforms, vegetation patterns, water characteristics, and cultural features combine to provide unusual, unique, or outstanding scenic quality,

Typical - Landforms, vegetation patterns, water characteristics, and cultural features combine to provide ordinary or common scenic quality,

Indistinctive – Landforms, vegetation patterns, water characteristics, and cultural features have low scenic quality.

Concern Level

1 – High
2 – Moderate
3 – Low

Scenic Integrity Level

VH – Very High (Preservation)
H - High (Retention)
M – Moderate (Partial Retention)
L – Low (Modification)
VL – Very Low (Maximum Modification)

Minerals-Coal/Gas/Oil

According to the West Virginia Department of Environmental Protection website, there are seven underground mining permits and one surface mining permit in this watershed.

With the introduction of powered equipment in the 1930's for underground mining operations and again in the 1940's for surface mining operations, coal mining production in the Watershed area increased. The surface disturbance of mining is visible on modern topographic maps. More recently, coal production has tapered off due to economic reasons.

Mining activity within the NFS portion of the Watershed is nearly non-existent. Along the eastern perimeter of the watershed boundary are a few locations where mining activity in the adjacent watershed area (Upper Shavers Fork) crossed the watershed boundary and include only a few acres.

Coal Prices (nominal dollars per short ton)	1999	1998	1997	1996	1995
Mine Total	$25.57	$27.07	$26.64	$26.58	$27.18
Underground	26.21	28.25	27.64	27.31	27.77
Surface	22.39	24.5	24.6	25.04	25.95

Source: Energy Information Administration

Summary	Total Coal Production (tons)	Avg Annual Coal Production (tons)	Est. Recoverable Reserves (tons)
	1883 - 1995	1986 - 1998	
Randolph	92,578,079	1,125,000	2,417,608,212

Source: WV Geologic & Economic Survey; http://www.wvgs.wvnet.edu

There was 139,217,000 Mcf (Million Cubic Feet) of natural gas produced in Randolph County from 1979 to 1999 according to West Virginia Geological and Economic Survey (WVGES). There were an average of 473 natural gas production wells from 1979 to 1999 in Randolph County. In the watershed area there are four documented wells, all on private land. All wells are plugged. All four wells were in the vicinity of Huttonsville. All four wells have no record of gas production. Two wells (830 0007 and 0011) were characterized as briney (1952). One well (830 0102) was characterized as a dry hole (1959). One well was drilled to extreme depths (>13,000 feet) with some show gas but it was never converted to production (1961). A fifth well (830 0156 – just outside the watershed area to the north) was drilled to a shallow depth and never put in production (1971). (WVDEP, Office of Oil and Gas, Website, 2002) A short stretch of gas transmission pipeline crosses the northern panhandle of the watershed area on private land.

Currently, there are no active gas operations in the watershed area, neither federal or private. There are no nominations pending for any of the federal lands in the watershed area. There also has not been any recent interest in performing seismic surveys in the watershed area.

Special Uses

The Resource Conservation and Recovery Information System (RCRIS) includes information on hazardous waste sites and solid waste sites including landfills. According to RCRIS data, there are three active landfills or dumps in the Upper Tygart Valley watershed. These are called Windy Run #1, Valley Head Cemetery Road Dump and Ralston Run Dump. Two of these sites are within ½ mile of National Forest System land.

Special uses and easements in the Upper Tygart Valley watershed include the following:

- R/W over private landowners Cleo & Ruth Tacy, Nippy Martin, Robert J. Shawkey, Lila Shreves, from 39/3 to U.S. Tracts 419 and 440.
- Allegheny Power - 80' r/w powerline across U.S. Tracts 519, 51h, and 491 for 5,292' carrying 138,000 volts.

- U.S. Tract 51h - Mower Lbr. Co. reserves all oil and gas hydrocarbons on Tract 51h (quitclaim deed 2/21/85) Union lease and any subsequent leases continue to be valid;
- U.S. Tract 51h - Special use permit for rain gauge to Randolph Co. Comm. - includes clearing of all overhead obstructions for 100' in all directions from rain gauge - (Permit 1996).
- U.S. Tract 379c - S.I. Furbee reserves 1/16th interest in minerals-1905-unlimited.
- U.S. Tract 379c - Special Use Permit - Allegheny Power (1989) - two anchor rods w/guy wires for 60' across Tr 379c to serve residence of Roy Crickard. R/w limited to 10', 5' each side of centerline - .01 acre.
- U.S. Tract 476a - Special Use Permit - Randal Wood has well, spring just south of Route 64 used for domestic reasons to serve home (original permit - 1978).
- U.S. Tract 476b - Three Special Use Permits - Danny L. Bamber, D.J. Marfitl & G. Darden, and Neil Pugh, Jr. across southern tip of tract to access private property (Permits issued 1993, 1993, 1994 respectively).
- U.S. Tract 515a – State of WV reserves easement for construction, maintenance of covered drainage as may be necessary.
- U.S. Tract 515a - Allegheny Power for 30' r/w for powerline for distance o f982' carrying 7200 volts; Access across private property of Ruth Linger Bell via FS Route 26 (Riffle Creek) from U.S. Route 250 (permit 1994).
- U.S. Tract 520 - Access across private landowner Charlie C. Wood Spur 1 Sec. Rte 64/1 Stewart Run - (1953) - 40', 1.53 miles.
- U.S Tract 521 - Access along McGee Run Road (FS Road 494) to from private landowners Russell Swiger and David Channell (both acquired 1951).
- U.S. Tract 541 - Easement for road r/w to K. D. Marshall (1912).
- U.S. Tract 568 - Tygart Valley Land Co. reserves oil and gas with right to mine and remove. (Unlimited)
- U.S. Tract 594a - Access over private landowner Manda S. Wamsley Spur 1 Sec. Route 43/4 Wamsley Run (1951) 30' wide, .38 mi.
- U.S. Tract 612 - S.I. Furbee et al reserves 3/16th interest in minerals on 0.40 acres of this tract - 1905 – unlimited.
- U.S. Tract 619 - State of WV has easement for 85' U.S. Route 250 (1933).
- U.S. Tract 619a - State of WV reserves easement for 85' width for US Route 250.
- U.S. Tract 823 - WVDNR Wildlife Managers Residence (1967);
- U.S. Tract 823 - US Army Corp of Eng. - self-sustained transmitting rain guage which includes antenna and solar panel at Huttons Knob Mtce Building (permit-1984).
- U.S. Tract 856 - Minerals and mineral rights outstanding of record to third parties.
- U.S. Tract 856 - Access over private landowners R.T. Maple and Charles See over Spur 1 of U.S. 219 called Baker Run Road (1967).
- U.S. Tract 888 - Vendor reserves minerals and right to mine and remove. (Consolidated Gas)
- U.S. Tract 888 - Easement by rights of prior use for 70 years by predecessors of Terry K. Hamilton for 12' road r/w being 0.73 mi. in length.
- U.S. Tract 1403gg - Allegheny Power - Powerline easement (1957-unlimited).
- U.S. Tract 1403gg - C.E. Beck - Outstanding oil and gas lease (1971 - Limited). Primary term of ten years - extended by drilling of wells on lease area.
- U.S. Tract 1403gg - Union Drilling-all oil and gas outstanding (1985-Unlimited).
- U.S. Tract 1403h - All coal, oil and gas and other minerals outstanding to Davis Land Co. on 385-acre residue of 450-acre Baxter Tract 27. This watershed is a portion of that 385-acre parcel.

- U.S. Tract 1403h - C.E. Beck has oil and gas lease for primary period of 10 years - term has been extended by drilling of wells on lease area - l971 – unlimited.
- U.S. Tract 1403h - Union Drilling - all oil and gas except Davis Land Co. 385-acre residue -1985 – unlimited.

Roads/Trails

Many of the existing roads on NFS and private lands in this area are old logging grades that run along intermittent drainages or in the floodplain. According to the roads database, there are about 162 miles of road within the Upper Tygart Valley Watershed. A gap in the roads data exists due to this watershed lying on the administrative boundary of the Forest. Many of the roads west of the Tygart Valley River are not included in the data set. The total road mileage in the watershed is actually higher due to several private roads that are not maintained by the WV Department of Highways (WVDOH). In general, many State, Forest Service, and private roads are in poor condition. Several roads are actively contributing sediment to the stream channel, especially at low water stream crossings. Culvert spacing, steep terrain, poor road location and inadequate stream crossings are all factors contributing sedimentation. Becky's Creek road (State Route 43) and Elkwater Fork road (State Route 58) are poorly placed in some areas with numerous low water crossings. Both roads are contributing substantial amounts of sediment to the streams. In addition, a side road leading to a picnic area in the Becky Creek Wildlife Management Area has a very steep grade on extremely steep side slopes with few culverts. Also, several state roads begin on private property, cross National Forest System land, and continue on through private land. These roads are open year around. There is an opportunity to enter into cooperative agreements with the WVDOH to improve these roads by adding stone and a sufficient number of properly sized culverts to reduce the amount of sediment entering nearby streams.

Several existing Forest System Roads (FR) are in poor condition including:

- FR 498 (Dry Run) and FR 432 (Fish Hole Run) begin on private land before entering National Forest System land. Both roads are open year around to access private cabins and are not well maintained. Additional stone with a sufficient number of properly sized culverts would reduce sediment run-off.
- All of FR 785A and a portion of FR 785 behind the earthen berm is receiving illegal ATV use. The portion of FR 785 behind the earthen berm is almost entirely in the Stewarts Run floodplain. FR 785A has some minor erosion, mostly caused by ephemeral channels crossing the road. This road would be well vegetated if not for the illegal ATV traffic. The illegal ATV traffic is crossing over the berm on FR 785 before the parking lot. They are also entering directly from the parking lot and accessing FR 785 below the berm.
- Infra data on FR 871 (Windy Run) shows the road should be closed with a gate after it crosses Windy Run and enters National Forest System land. A field review revealed the gate is no longer there and four-wheel drive vehicles are using the road frequently. This deeply rutted road follows Windy Run closely for its entire length, and crosses four perennial tributaries on National Forest System land. There may be an opportunity to abandon FR 871 and construct an extension of FR 233A from Shavers Fork to access this area.
- FR 921 parallels and is in between FR 92 and US Highway 250. This road may not be needed for the long-range transportation system. Although the earth berm no longer is functional to block traffic, the road is not being used due to trees growing in the road. There is an opportunity to abandon this road or put it in storage.

A field review for the Stewart's Run Environmental Analysis was conducted in October 1996. The report reviews the feasibility of constructing roads in Stewart's Run drainage for timber removal. Drainages were generally deep and wide with moderate to steep side slopes. Three major drain crossings were required for the road construction. The channel at the crossings was described as having rock that would possibly require blasting to prepare a pipe bed. Slopes in the Stewart Run drainage range from 20-50 percent. The hydrologist's report noted that many areas were extremely wet and existing roads ran along small streams. The proposed crossings were located on deeply incised channels with very steep approaches. The channel bottoms were primarily bedrock and large boulders.

In August 2000, a Forest Development Project was signed called the Swecker Ridge Project. This project involved the reconstruction of almost two miles of Forest Roads 785 and 785A. The Forest Hydrologist's notes on the project made references to the steep, rocky terrain in the area. Some of the slopes in the area were measured in excess of 80 percent. The geology in this area included Greenbrier Limestone. Some portions of the road surface had grades up to 18 percent. Skid trails were found that had grades of 22-31 percent grades. Drainages in the area were described as deeply entrenched with moderate slopes above. Functional ephemeral channels were found high up in the headwaters of the drainages. Large stone has been placed along the entire length of FR 785. This road and FR 785A are now blocked with an earthen berm before reaching the floodplain of Stewarts Run. A parking area was created at the berm for hikers, hunters, and fishermen to access Stewarts Run year around.

The 5.5 mile Chestnut Ridge (#327) trail is the only Forest Service system trail within the assessment area. It follows the northern boundary of the assessment area for only a short distance before turning north out of the area. This trail is relatively steep with elevation gains of 1400 feet over its duration. Although not recommended, equestrian and bicycle use is permitted. Currently hiker use is low but mountain bike use is increasing. Illegal use of ATV's on the trail has been identified. A segment of this trail from FR-92 to road 1164 is in poor condition (only a portion in this assessment area) and should be rehabilitated. Trail densities on system trails are currently less than .1 mile/ square mile. There are two abandoned/ not maintained trails within the assessment area. They are the McGee Run (TR-328) and the Laurel Run (TR-331) Trails. The condition of these trails is currently unknown and a survey should be conducted to identify potential uses and/or rehabilitation opportunities.

Table 3.12 - State and Federal Roads within Upper Tygart Valley watershed

Road	Length (miles)	Quad(s)	Remarks
	(approximate)		
ss219/16	9.6	Adolph, Valley Head	one lane paved 0.5 mi.
ss219/26	1.3	Adolph	
ss39	1.08	Mill Creek	
ss39/3	0.59	Mill Creek	
ss42	2.7	Mill Creek, Adolph	one lane paved 1.0 mi.; very few culverts, eroding ditchline, dumps
ss46	3.0	Mill Creek, Beverley West	two lane paved
ss46/3	1.5	Mill Creek, Beverley West	one lane paved 1.5 mi.
ss46/4	2.9	Mill Creek, Adolph	one lane paved 1.9 mi.
WV 92, US 250	10.62	Mill Creek, Snyder Knob	two lane paved
ss56	5.13	Mill Creek, Adolph	
ss56/1	1.13	Mill Creek, Adolph	
US 219	23.41	Mill Creek, Adolph, Valley Head	two lane paved
ss43 Becky Creek	7.39	Mill Creek, Snyder Knob, Adolph	
ss43/2	1.50	Mill Creek	
ss43/4	1.67	Snyder Knob	
ss43/3	0.87	Mill Creek	
ss64 Conley Run	3.15	Snyder Knob, Valley Head	
ss64/1 Conley Run	2.45	Snyder Knob, Valley Head	
WV 15	4.02	Valley Head	two lane paved
ss15/2	0.5	Valley Head	
ss15/3	4.5	Valley Head	one lane paved 0.8 mi.; very few culverts
ss15/5	1.4	Valley Head	one lane paved 0.4 mi.; dirt/gravel section outsloped w/ no culverts
ss45 Turkeybone	2.53	Valley Head	
ss45/9	1.1	Valley Head	
ss49	0.10	Valley Head	
ss58 Elkwater Fork	6.93	Valley Head	gravel/dirt; several low water fords.
ss62	3.06	Valley Head	
ss64 Windy Run	3.19	Valley Head	
ss64/2 Windy Run	1.96	Valley Head	
ss66 Logan Run	2.89	Valley Head	one lane paved 1.1 mi.
ss66/1	1.16	Valley Head	
ss66/2	1.37	Valley Head	
ss51	2.50	Mingo	one lane paved 0.4 mi.
ss51/1	0.47	Mingo	
ss219/13 Big Run	1.73	Mingo	one lane paved 0.7 mi.
ss219/14	1.87	Mingo	gate at 0.7 mi.
Total	**121.27**		
		83.31 miles within the forest boundary in the watershed.	

Table 3.13 - Woods Roads within Upper Tygart Valley watershed

Road	Length (miles)	Total Length (miles)	Quad
		(approximate)	
GR-1-RR	1.08	1.08	Valley Head
GR-2	0.08	0.08	Valley Head
GR-3	0.38 private and 0.39 govt	0.77	Valley Head
GR-5	0.67	0.67	Valley Head
GR-4	0.22 private and 0.03 govt	0.25	Valley Head
GR-6	0.37	0.37	Valley Head
GR-7	0.04 private and 0.25 govt	0.29	Valley Head
GR-8	0.10 private and 0.10 govt	0.20	Valley Head
GR-9	0.20 private and 0.10 govt	0.30	Valley Head
GR-10	0.29	0.29	Valley Head
GR-1	0.31 private and 0.27 govt	0.58	Snyder Knob
GR-2	0.08 private and 0.30 govt	0.38	Snyder Knob
GR-3	0.13 private and 0.13 govt	0.26	Snyder Knob
GR-6	0.32	0.32	Snyder Knob
GR-5 RR	1.31 RR Grade	1.31	Snyder Knob
GR-7	0.55	0.55	Snyder Knob
GR-8	0.6	0.60	Snyder Knob
GR-9	0.37 private and 0.34 govt	0.71	Snyder Knob
219-13	0.55	0.55	Snyder Knob
GR-15 RR	0.89	0.89	Mill Creek
GR-16 RR	0.37	0.37	Mill Creek
GR-17 RR	1.07	1.07	Mill Creek
GR-18	0.21 private and 0.15 govt	0.36	Mill Creek
GR-55	0.27	0.27	Mill Creek
GR-58	0.43	0.43	Mill Creek
GR-3	0.36	0.36	Mill Creek
GR-56	Same as and counted as State 43/2		Mill Creek
GR-57	0.32	0.32	Mill Creek
GR-59	0.07 private and 0.30 govt	0.37	Mill Creek
GR-49	1.08 (check, beginning private?)	1.08	Mill Creek
GR-50	0.39 (steep)	0.39	Mill Creek
GR-51	0.31	0.31	Mill Creek
GR-52	0.1	0.10	Mill Creek
GR-53	0.43	0.43	Mill Creek
GR-54	0.63	0.63	Mill Creek
Part GR-21	0.58	0.58	Mill Creek
Part GR-28	0.1	0.10	Mill Creek
Part GR-33	0.9	0.90	Mill Creek
Part GR NE 78/79	0.13	0.13	Mill Creek
Part GR-40	0.05	0.05	Mill Creek
Part GR-38	Begin Part 0.03, End Part 0.30	0.33 in watershed	Mill Creek
	Total	**19.03**	

Table 3.14 Specified National Forest System Roads within Upper Tygart Valley watershed

Road	Road Name	Begin Termini	End Termini	Length (GIS miles)	Surface	Maintenance Level	Functional Class	Closure	Quad(s)
				(approximate)					
fs26	Riffles Creek	US 250 - MP 0.50	MP 0.50 - Dead end	0.40	Crushed Aggregate	3-Suitable for Passenger Cars and 2-High Clearance Vehicles	Collector	Closed - Gate	Mill Creek
fs92	Cheat Mtn	US 250 - MP 2.80	MP 12.40 - ST 37	3.18	Crushed Aggregate	4- Moderate Degree of User Comfort	Arterial	Open - Maintained	Mill Creek
fs498	Dry Run	St 43	Dead End	2.51	Native Material	2-High Clearance Vehicles	Local	Open - Maintained	Mill Creek
fs758	Stone Coal South	Rd 92	Dead End	0.14	Improved Native Material	2-High Clearance Vehicles	Collector	Closed - Gate	Mill Creek
fs759	Stone Coal North	Rd 92	Gas Well	0.03	Improved Native Material	2-High Clearance Vehicles	Local	Closed - Gate	Mill Creek
fs765	Back Fork	FS1560	MP 2.16	1.90	Improved Native Material	2-High Clearance Vehicles	Local	Closed - Gate	Mill Creek
fs765a	Back Fork - A	MP 1.58	End	0.77	Improved Native Material	1-Basic Custodial Care	Local	Closed - Gate	Mill Creek
fs789	Stone Coal	Rd 92	Dead End	0.16	Improved Native Material	2-High Clearance Vehicles	Local	Closed - Gate	Mill Creek
fs921	Cheat Mtn Spur	Rd 92	End	1.02	Native Material	1-Basic Custodial Care	Local	Closed - Berm	Mill Creek
fs1560	West Side Cheat Mtn	US 250	MP 6.01	3.23	Improved Native Material	2-High Clearance Vehicles	Collector	Closed - Gate	Mill Creek
fs1560a	West Side Cheat Mtn-a	RD1560	End	0.07	Crushed Aggregate	1-Basic Custodial Care	Local	Closed - Gate	Mill Creek
fs227	Old Mine	ST 92	FR 233	1.03	Native Material	3-Suitable for Passenger Cars	Collector	Open - Maintained	Mill Creek, Snyder Knob
fs785	Swecker Ridge	ST 64/1	Dead End	1.62	2″ - 4″ Limestone Rock	2-High Clearance Vehicles	Collector	Open to Berm	Snyder Knob
fs785a	Swecker Ridge - A	785	End	1.04	Native Material	1-Basic Custodial Care	Local	Closed – Berm	Snyder Knob
fs432	Fish Hole	ST 64	Govt	0.91	Improved Native Material	1-Basic Custodial Care	Local	Open - Maintained	Valley Head
fs871	Windy Run	ST 64/4	Dead End	1.64	Native Material	2-High Clearance Vehicles	Local	Closed – Gate (missing)	Valley Head
fs1566	No information in Infra - The road appears to lie almost entirely on private land.			2.22					Valley Head
			Total	**21.87**					

Heritage Resources

The European presence on the landscape changed everything. Colonization of the region began in earnest after more than a century of socio-economic disruption, demographic decline, disease, and three wars involving Indians and Europeans. A series of forts and trading posts were established in this portion of what was then Virginia between 1760 and 1791. After the conquest and pacification of the Ohio Valley tribes in the 1790s, the earliest towns were chartered; the first and nearest to the watershed was Edmunton (later Beverly). The area around Marlinton, first settled in the 1750s, remained thinly settled and relatively undeveloped until the late 19th century. By 1870 the population of Randolph County had grown to 5,563. Beginning in the 1890s, the promise of growth and prosperity through the exploitation of coal and timber, aided by rail transport, saw the birth of numerous planned communities in West Virginia. The towns of Huttonsville and Mill Creek were formed in 1890 and 1903 (Reger 1931). In 1920, during the peak of the timber boom, the population of Randolph County reached 26,904 people and has remained relatively constant over the past 80 years with a population of 28,267 estimated in 2002 (US Census Bureau website www.census.gov 2003).

The past 250 years witnessed more major changes to the landscape and impacts on the environment than the cumulative impact of 12,000 years of Native American land-use. By some estimates, upwards of 30 billion board feet of timber were cut in West Virginia between 1870 and 1920 (Clarkson 1964). The area was also subjected to slash fires and was more severely flooded as a result of increased surface runoff. Recognizing the devastation brought about by unregulated logging, President Wilson declared the boundaries of the Monongahela National Forest in 1920. Subsequently, significant reforestation was accomplished through the efforts of the Civilian Conservation Corps in the 1930s. Under the stewardship of the National Forest System, the area is once again thriving, albeit with significantly altered floral, faunal, sediment, and hydrological regimes.

Exhaustion of the forests, coupled with the Great Depression, brought about a precipitous economic and social decline. Many towns and small communities were abandoned. Within the assessment area, the infrastructure aspects of this settlement/industrial system (i.e., homes, farms, schools, mill sites, transportation systems, etc.) tend to cluster around Beverly. Within National Forest System lands, much of this infrastructure now exists only as archaeological sites and some “cultural landscapes”.

Results of previous archaeological surveys indicate that historic period activity in the area was divided between agriculture and resource extraction, particularly mining and logging. A comparatively large proportion of historic period sites located in the watershed were devoted to human habitation. These include numerous homesteads and other historic period structures. They tend to be clustered along the major travel arteries, along the valley floor itself and the Staunton-Parkersburg Turnpike. This turnpike was the most important transportation artery in this part of the United States at the time of its construction, as it linked the Ohio Valley with East Coast. The turnpike linked Staunton,

Virginia, with Beverly and on to Weston by 1845, and was completed to Parkersburg on the Ohio River by 1847. Several early engagements of the Civil War, including the Battle of Rich Mountain and the engagements between the Union forces at Cheat Summit Fort and the Confederate forces at Camp Allegheny, were fought over control of this vital transportation artery. The historic period occupation of the area was focused on the town of Beverly until the relocation of the county seat to Elkins in 1899.

The vast majority of the watershed has felt the impact of human use. Some impacts, although not currently measurable, occurred between the 18th and early 20th centuries. These would have included impacts to forest species age and diversity, wildlife populations, soils, viewsheds, fragmentation/openings ratios, and the demographic profile of the area (Indian-to-colonial; low-to-moderate population density). The most dramatic changes, however, took place after the colonization of the area after the middle 18th century.

There are numerous sites and features left on the landscape; they are the correlates to the standing architecture and functional outbuildings of the historic economy. We would therefore expect the remains of communities, houses, barns, outbuildings, mills, blacksmith shops, schools, logging camps, mining structures, etc. Also, the footprints of transportation systems, and vegetative "artifacts" in the form of complete and partial cultural landscapes (apple orchards, pine plantations, sugar bushes, openings, and more) will likely be located. Their distribution is heavily biased toward the main transportation arteries.

A total of 23 Heritage Resource surveys have been conducted either wholly or partially within the current watershed assessment area between 1979 and 1998, resulting in the identification of 18 sites. The total area in acres covered and sites located by these surveys, both within and outside of the assessment area, are shown in Table 3.15

Table 3.15 - Previous Cultural Resources Surveys in the Upper Tygart Valley Watershed Assessment Area: Acres Covered and Results.

Project Name	Total Acres	Total Acres in Watershed	Total Number of Sites Located	Number of Sites Located in Watershed
Riffle Creek TS	843	447	1	1
Whitmeadow TS	860	9	1	1
Riffle Creek TS – Timber cutting Research	17	17	1	1
Shavers Run TS	939	443	1	1
Small Sales – FY 83	399	19	2	0
McGee Run Oak Salvage Sale	50	50	0	0
Cheat 92 Preroad	9	9	0	0
Beckys Creek TS	567	508	4	4
Red Run TS	620	11	1	0
Small Sales – FY 86	138	98	2	1
Small TS – Black Fork Locust	363	306	2	2
Small TS – Long Run Locust	45	18	0	0
Chestnut Ridge TS	60	8	1	1
Blowdown Sale – FY 93	100	55	0	0
A Phase I Survey of Portions of the Greenbrier RD	1757	879	10	5
Woods Tract Land Exchange	29	29	0	0
Crouch Run OA	3916	69	0	0
Stonecoal OA	3803	114	0	0
Coastal Lumber ROW	3	3	0	0
Shaver Fish For Fun SUP	55	1	0	0
Stewart Run Sediment Reduction	13	9	0	0
Bamber Road SUP	4	4	0	0
Survey of the Fore Knobs and Cheat Mountain Pipeline	100	67	7	1
TOTALS	**14690**	**3173**	**33**	**18**

This previous survey data indicates that all but one of the heritage surveys were project-driven. Surveys have been conducted primarily for timber sales, followed in order of

importance by roads, special use permitting and lands. No archaeological site evaluations have been carried out in the project area.

Based on a GIS projection of the Forest's soil survey data, of the 16,617 acres of National Forest System land contained within the assessment area, 1,724 have slopes of 15 percent or less. Landforms with slopes of 15 percent or less are considered to have a moderate to high probability of containing historic or prehistoric resources. However, of the 3,173 acres previously surveyed, only 438 of these were moderate to high probability acres. Thus there are 1,286 moderate to high probability acres remaining to be surveyed.

A total of 57 heritage resources have been recorded previously in the Upper Tygart Valley Watershed Assessment area. Of these, 33 represent the remains of prehistoric resource exploitation and/or habitation. Twenty-three sites represent Euro-American historic period activities; one of these is an 18th century fort. The vast majority of historic sites (n=17) represent the remains of permanent habitation and/or settlement activities. Table 3.16 presents information on each of these sites. Sites are presented by site number without reference to a specific physical locations. Such locations will be made available to Forest personnel as part of planning for specific management actions.

Table 3.16 Previously Identified heritage sites in the Upper Tygart Valley Watershed Assessment Area.

Site Number	Site Type	Period	Ownership	Evaluation Status
03-064	Fort	Historic	Private	Unevaluated
03-066	Sawmill	Historic	Forest Service	Unevaluated
03-069	Village	Prehistoric	Private	Unevaluated
03-070	Civil War Earthworks	Historic	Private	Unevaluated
03-071	Mound	Prehistoric	Private	Not Eligible
03-072	Village	Prehistoric	Private	Unevaluated
03-074	Mound	Prehistoric	West Virginia	Not Eligible
03-075	Mound	Prehistoric	West Virginia	Not Eligible
03-077	Mound	Prehistoric	Forest Service/ Private	Unevaluated
03-078	Mound and Village	Prehistoric	Private	Unevaluated
03-079	Village	Prehistoric	Private	Unevaluated
03-080	Campsite and Village	Prehistoric	Private	Unevaluated
03-113	Unidentified Structure	Historic	Forest Service	Unevaluated
03-116	Unidentified Structure	Historic	Forest Service	Unevaluated
03-117	Lithic Scatter	Prehistoric	Forest Service	Eligible
03-119	Homestead	Historic	Forest Service	Unevaluated
03-121	Unidentified Structure	Historic	Forest Service	Unevaluated
03-124	Homestead	Historic	Forest Service	Unevaluated
03-125	Unidentified Structure	Historic	Forest Service	Unevaluated
03-126	Unidentified Structure	Historic	Forest Service	Unevaluated
03-141	House	Historic	Private	Eligible
03-143	Log Cabin	Historic	Private	Unevaluated

Site Number	Site Type	Period	Ownership	Evaluation Status
03-147	Salt Springs	Historic	Private	Unevaluated
03-163	CCC Camp	Historic	Private	Unevaluated
03-174	CCC Camp	Historic	Forest Service	Unevaluated
03-211	Lithic Scatter	Prehistoric	Forest Service	Unevaluated
03-212	Homestead	Historic	Forest Service	Unevaluated
03-213	Homestead	Historic	Forest Service	Unevaluated
03-221	Lithic Scatter	Prehistoric	Private	Unevaluated
03-222	Lithic Scatter	Prehistoric	Forest Service	Unevaluated
03-223	Lithic Scatter	Prehistoric	Forest Service	Eligible
03-233	Isolated Find	Prehistoric	Forest Service	Unevaluated
03-238	Lithic Scatter	Prehistoric	Forest Service	Unevaluated
03-240	Lithic Scatter	Prehistoric	Forest Service	Unevaluated
03-241	Stone Piles	Unknown	Forest Service	Not Eligible
03-244	Residence	Historic	Forest Service	Unevaluated
03-246	Lithic Scatter	Prehistoric	Forest Service	Not Eligible
03-260	Lithic Scatter	Prehistoric	Private	Unevaluated
03-261	Lithic Scatter	Prehistoric	Private	Unevaluated
03-262	Lithic Scatter	Prehistoric	Private	Unevaluated
03-263	Lithic Scatter	Prehistoric	Private	Unevaluated
03-266	Lithic Scatter	Prehistoric	Private	Unevaluated
03-369	Lithic Scatter	Prehistoric	Forest Service	Unevaluated
03-370	Rockshelter	Prehistoric	Forest Service	Unevaluated
03-371	Lithic Scatter	Prehistoric	Forest Service	Unevaluated
03-375	Lithic Scatter	Prehistoric	Forest Service	Not Eligible
04-099	Civil War Camp	Historic	Private	Unevaluated
03-068	Mound and Village	Prehistoric	Private	Eligible
03-076	Mound	Prehistoric	Private	Not Eligible
03-102	Unidentified Structure	Historic	Private	Unevaluated
03-209	Homestead	Historic	Forest Service	Unevaluated
03-230	Quarry	Prehistoric	Private	Unevaluated
03-245	Isolated Find	Prehistoric	Forest Service	Not Eligible
03-255	Lithic Scatter	Prehistoric	Forest Service	Not Eligible
03-319	Lithic Scatter	Prehistoric	Private	Unevaluated
03-367	Homestead	Historic	Forest Service	Unevaluated
03-368	Farmstead	Historic	Forest Service	Unevaluated

It should be noted that all of the sites numbered 168 and below (n=28 or 49 percent) are sites that were recorded in 1977 and 1978 during the initial Cultural Resources survey of the Forest (Davis 1978). This survey involved checking historic period maps and West Virginia Geological Survey site records for sites on Forest Service land. No actual fieldwork was involved. Of these 42 archivally identified sites, only ten were located on Forest Service land. Of these, six were subsequently located in the field; four remain to be looked for. Given the fact that the total success rate on the District for locating these

archival sites is approximately 82 percent, it is possible that some of the sites listed in Table 3.16 may not be located in future.

Landlines

Recent trespasses indicate the need for increased landline surveys that meet today's standards and maintenance. Of approximately 112.3 miles of landlines in this watershed, about 39.4 miles are not marked to standard. Funding has not been adequate to meet this need.

Private Land

Developments occurring within the watershed include Becky's Creek Cabins and Woods Run homes located adjacent to U.S. Tract 430.

Chapter 4 - Synthesis and Interpretation

Synthesis and Interpretation

The Interdisciplinary Team met on Wednesday, July 2, 2003 to discuss the Upper Tygart Valley Watershed Assessment to determine any significant difference, similarity, or trend between the reference and existing conditions. Discussions centered on the core topics of the assessment and the capability of the system to achieve key management plan objectives.

Erosion Processes

Steep slopes are a big concern in Upper Tygart Valley. The soils report has identified many areas of topography that are greater than 50 percent slope. The Chemung and Hampshire geologic formations underlie the majority of the watershed. The Mauch Chunk geologic formation is present in the headwaters of many of the sub-watersheds and at the head of Tygart Valley River. Soils that form over this geology are prone to mass movement especially when disturbed. The concern over the erosive process in these areas may shape or limit management activities to protect these soils. Frigid soils at the higher elevations and Karst topography with several cave openings are known to exist within this watershed.

Air Quality/Acid Deposition

Acid deposition is not a major concern in the National Forest System portions of this watershed. Much of the most sensitive topography underlain by the Pottsville geologic formation lies on private lands on the eastern side of the watershed. The soils that form on the Hampshire and Chemung geologies are moderately sensitive to acid deposition; however we have no data in this watershed to give us site-specific information. Some mitigation measures may be incorporated into environmental analyses to protect those soils in the area when planning timber harvests such as: 1) leave pulpwood lying on the ground when cut for nutrient recycling, 2) leave and scatter the tops of trees, 3) conduct minimal harvesting until further knowledge of the soil quality can be obtained of the area through monitoring.

Hydrology/Stream Channels

Flood events are fairly common in the watershed, although no major flooding has occurred for some time. Management activities on private lands are likely speeding runoff to streams in flood events. Much of the Tygart Valley River has been channelized from Huttonsville upstream, and major portions of some tributaries, such as Riffle Creek.

Additional areas of concern for this area are:

- Some roads on private land are not built to standards and are causing sedimentation problems.
- Some NFS roads are also sources of sediment, partly due to uncontrolled illegal ATV use.
- The majority of the soils in the watershed have a severe potential rating for erosion hazard.
- Riparian area condition, especially on private lands.
- Channel-erosion and stability.

Water Quality

Water quality is directly related to hydrology, geology, and soils. Some excessive sediment is found in Stewart Run and Becky Creek. Soil erosion in Stewart Run is not severe but illegal ATV traffic is exacerbating the problem. There are more severe sediment impacts at Becky Creek with the majority of it coming from private land. Several low water stream crossings on State Road 43 near the headwaters of Becky Creek are contributing to the sediment load. Also a private road that connects to a FS road from Stewart Run to Becky Creek has soil erosion problems that need to be fixed. FR 871 parallels Windy Run for several miles. Illegal ATV traffic on National Forest System land above the stream crossing contributes a substantial amount of sediment during storm run off. A gate that had been installed was not effective in controlling access.

Wildlife openings along Stewart Run are located in riparian zones. Access to maintain the openings are of concern because of illegal ATV traffic utilizing the access route. Consider abandoning these openings to grow into forested conditions or maintain with other methods, such as prescribed burning, and obliterate the road leading to the openings.

Aquatic Resources

Fine sediment loading inhibits aquatic productivity. Habitat complexity from loss of LWD has degraded aquatic habitat. More large wood in stream channels would benefit long-term channel stability, and substantially improve aquatic habitat. Management activities should focus on minimizing or reducing fine sediment inputs, protection of existing habitat, and creation of additional habitat through placement of LWD in streams.

Several streams in the watershed are on the State's impaired streams list. They are listed as biologically impaired because of acidity and/or sediment issues. Meatbox Run, Glade Run, Potatohole Fork, and Riffle Creek are streams that are included in this list.

Vegetation

Extensive clearcutting at the turn of the 20th century and active forest management over the past 40 years resulted in today's existing forest. Over 85 percent of National Forest System Lands are now between 60 to 120 years old. The current condition allows for achieving a more balanced age class distribution. Harvesting some stands of trees would provide space for young trees to grow, while trees in older stands can be left to mature into old growth habitat. Management activities should focus on continuing the use of silvicultural harvest methods that would maintain or increase the diversity of forest tree and herbaceous species while providing economic opportunities for the local communities through commercial timber sales.

Emerging fronts of non-native insects and diseases are increasing mortality of native trees. Invasive non-native plants threaten to reduce the native forest tree, shrub, and herbaceous species. Pro-active management is needed to reduce the impact and retain the natural biodiversity on forested land.

Overall the majority of the National Forest System land in the watershed is inaccessible for conventional logging due to scattered ownership. Much of the National Forest System land is surrounded by privately owned land. Additional road construction to access these parcels would be difficult and costly due to steep slopes and soils with high erosion potential. Most of the remainder of the project area will most likely be suitable for harvest by helicopter.

Chestnut Ridge area will be one of the locations for potential projects. The majority of the road system in that area is adequate for conventional harvesting. However, some helicopter logging may take place in areas that are steep and/or have difficult access. Locating a helicopter landing on the soils in the area of Chestnut Ridge will need to be reviewed by the soil scientist due to the potential for slippage of soil material. The soil material in this area does not make a good surface for winter operations that are sometimes necessary for hauling logs during helicopter logging operations. Some road reconstruction work and additional stone may be needed on forest roads to provide for all-season hauling.

Stewart Run area also has some project potential. FR233A and FR 227 in Shaver's Fork watershed could be used to access some portions of National Forest System land in Stewart Run and Becky Creek sub-watersheds.

Patches of running buffalo clover are known to exist in the Stewart Run sub-watershed. There are bands of limestone geology along the boundaries of the watershed running NE to SW. Botany surveys may reveal additional populations of running buffalo clover and other TES plants in these areas. Non-native invasive species are a concern in the area. Botany surveys should begin during the 2004 field season.

Wildlife

In their pristine condition, the WV Mountains were covered with lush forests. River valleys supported oaks, walnut, sycamore and yellow poplar. Mountain coves held dense stands of oak, hickory, walnut, ash, basswood, maples and other hardwoods. Higher mountain areas held northern hardwood species and pine. Ridges and upper slopes held a finger-like projection of boreal forest (Stephenson 1993).

In pre-colonial day, white-tailed deer were distributed across the state in abundance. Over hunting thinned out the herds and local scarcities of deer were noted as early as 1841. As timber cutting swept across the state, the deer were decimated by market hunting. By the early 1900s the remaining deer were concentrated in scattered herds in remote areas of high mountains. In 1933, WV embarked on a deer re-stocking program that continued until 1957. Given hunting laws and the availability of a tremendous food resource provided on the cut over forest lands, deer herds increased dramatically.

Wild turkeys were extremely abundant throughout WV, but destruction of the forests by logging and subsequent uncontrolled fires, coupled with over hunting by shooting and trapping decimated these original populations. As forests regenerated and matured, wild turkey reintroduction into suitable range reversed the downward trend of the species. Successful transplanting of turkey around the state was instrumental in establishing viable populations.

The study of birds in WV extends back into the early 19th century. Birds vary in number and distribution as their habitats change. These changes may occur rather quickly and are often not unnoticed by the hundreds of active birdwatchers in WV today. In 1983, *West Virginia Birds: Distribution and Ecology* brought together all known information on bird distribution on the state.

The history of amphibian and reptile studies in WV has mostly occurred within the last 100 years. The first amphibian and reptiles list was published in 1929 and was based primarily on specimens contained in WV University's zoology museum. The first significant survey of WV herptofauna was made during the summers of 1935, 1937 and 1938. The first key to specifically address the reptiles and amphibians of WV was published in 1941. This key listed 37 different amphibians and 32 different reptiles. The only recent comprehensive book regarding WV amphibians and reptiles lists 43 different amphibians and 42 reptiles (Green and Pauley 1987). Although long-term historical data is lacking, salamander populations have declined since European colonization. Deforestation, habitat fragmentation, timber harvesting, urban growth and stream pollution are reasons for this decline. Many salamanders are sensitive to intensive timber practices that greatly modify soil moisture and temperature. Numerous studies document the decline in salamander populations immediately following timber harvesting.

Forested stands are mostly in the 60 to 120 year old age classes. These age classes represent the peak mast producing years of most tree species. As these older age classes mature they will begin to decline in their mast production capabilities. Management

activities should focus on creating early successional habitat from some of the stands in the 70 to 100 year old age classes (no more than 7-1/2 percent of the watershed) to provide for long term mast production capabilities. In addition, management should determine which stands are best suited for future old growth potential to provide habitat for those species that prefer old growth.

The watershed contains habitat for threatened and endangered species as well as plants and animals on the Region 9 sensitive species list. Management activities should focus on protection and enhancement of these species and their habitat. Bat surveys were completed this summer within the watershed.

Savannahs on Chestnut Ridge will need maintenance during this entry period.

Human Uses

Human impacts have been present in this watershed for thousands of years. People are an inherent part of this watershed and will continue to have impacts on the resources provided by terrestrial and aquatic ecosystems. Numerous archeological sites have been located within this watershed. Management activities should focus on conservative use of the multiple resources in these ecosystems to ensure a sustainable supply over the long term for animals (including humans) and plants.

Recreation use within this watershed is limited to mostly hunting, fishing, and hiking. There is one active trail. Another trail has been abandoned. The Scenery Management System (SMS) will be incorporated into the analyses for any visually sensitive projects, especially in the Crouch Knob area.

Most of the National Forest System roads are in fairly good condition with the exception of FR 871 Windy Run. Illegal Off Road Vehicle (ORV) access is causing severe rutting and contributing to sediment deposition in Windy Run. The first section of FR 785 (Swecker Ridge Road) was recently reconstructed and is now in stable condition up to the new parking area near Stewart Run. A portion of FR 785 and all of FR785A in Stewart Run have been blocked by an earth berm, but illegal ATV traffic is still able to access these roads. The state and National Forest System roads in Becky Creek sub-watershed that begin on private land, cross National Forest System land, and continue back on private land need to be upgraded with additional stone and a sufficient number of adequately sized culverts. This is also the case with FR 432 in Fish Hole Run. There is potential for a cooperative agreement with the State to help maintain some of the roads since Forest Service, private, and State roads all connect in the area.

All grazing activity in this watershed occurs on private land, mostly in the riparian area and adjacent lands along the Tygart Valley River. There are no grazing allotments in this watershed on National Forest System land.

Some National Forest System land in this watershed contains outstanding privately owned minerals rights. Reclaimed mines along the eastern edge of the watershed boundary are unlikely to be contributing acidic discharge into the streams.

Chapter 5 Findings/Recommendations/Actions

Findings/Recommendations/Actions

Table 5-1 contains, by core topic, the findings, recommendations, and actions needed to document and implement management projects for watershed improvement/restoration. Detailed information to support these recommendations can be found in Chapter 3 and/or resource reports provided by Forest Specialists for the Upper Tygart Valley watershed. Any deviation from the standards and guides listed in the Forest Plan must be described with appropriate mitigation measures in a NEPA compliance document.

Table 5-1. Findings/Recommendations/Actions

FINDING	RECOMMENDATION	ACTION NEEDED
Erosion Processes		
Erosion Control	Locate sources of sediment (such as along roads, trails and railroads), prioritize needs, and implement projects to stabilize the sites.	Identify/Prioritize/Repair/Monitor/Maintain sites for erosion control and sediment reduction - prepare NEPA document – if needed.
Hydrology/ Stream Channels		
Degraded stream channels.	Improve channel stability by using natural design methods and strategic placement of “Rosgen structures”. Project sites to be determined through site-specific analysis.	Coordinate with WV Department of Highways/Forest Engineer through maintenance or NEPA document.
Water Quality		
Various woods roads are contributing excessive sediment to nearby streams.	Repair problem areas along roads, identify culverts that are too small and replace with larger culverts. Maintain clean ditch lines and clean debris out of culverts or replace small culverts with larger culverts. Seed bare soil and place silt fences or hay bales to minimize sediment transport. Abandon or obliterate roads not needed for long term transportation plan.	Complete Long Range Transportation Plan. Schedule maintenance or reconstruction needs – prepare NEPA document – if needed. Monitor.

FINDING	RECOMMENDATION	ACTION NEEDED
Water Quality (cont.)		
Skid and haul roads used for timber harvesting may contribute additional sediment to streams.	Utilize standards/guidelines in Forest Plan to minimize additional sediment in streams. Incorporate newly adopted riparian buffer strips where needed. Consider helicopter logging on steep slopes or sensitive soils.	Prepare NEPA document, implement, and monitor.
Aquatic Resources		
Lack of large wood debris (LWD) in stream channels.	Identify areas to place LWD in stream channels or passively recruit LWD by leaving trees in riparian areas. Trees utilized for LWD placement should be directionally felled and selected to minimize solar radiation to streambed.	Retain no harvest buffer strips along stream channels for passive LWD recruitment or prepare NEPA document if placing LWD in streams. Monitor.
Elevated fine sediment levels in some streams.	Continue sediment sampling efforts on National Forest System Land. Work with WVDEP and Forest Engineer to locate and repair sediment sources on mines and roads.	Maintenance/restoration/ reconstruction – prepare NEPA document – if needed. Monitor.
Some road culverts may be restricting access to upper stream reaches.	Identify culverts that are restricting passage of aquatic organisms and replace with structures that would allow easier access.	Prepare NEPA document, implement, and monitor.
Presence of non-native aquatic species.	Emphasize and encourage the recovery of native aquatic species in the watershed.	Coordinate with DNR.
Presence of sensitive native aquatic species.	Conduct surveys to characterize existing aquatic habitat and population inventories of fish and other aquatic species.	Coordinate with DNR.
Vegetation		
Presence of non-native invasive plants.	Use only native plant species in seed mixtures, when possible. Develop seed/lime/fertilizer mixtures based soil type, soil pH, and soil fertility. Prepare plan for control or eradication of non-native invasive plants with herbicides, prescribed burning, mechanical treatments or other appropriate method.	Consult with Certified Silviculturist, Forest Botanist, and/or Forest Soils Scientist. Prepare NEPA document and monitor.
Presence of native TES plant species.	Determine why plant species are on the TES list. Conduct botany surveys. Maintain or increase the TES plant populations through protection, management, propagation, and/or planting.	Consult with Forest Botanist and Certified Silviculturist. Prepare NEPA document if needed.
Red spruce forest type has been substantially reduced from reference condition.	Encourage germination of red spruce seeds and release of seedlings and saplings through commercial timber harvests.	Prepare NEPA document, implement, and monitor.

FINDING	RECOMMENDATION	ACTION NEEDED
Vegetation (cont.)		
Non-native insects and diseases are changing forest vegetation structure.	Monitor insect and disease locations/infestations. Remove susceptible, diseased, dying, and dead trees through commercial or non-commercial timber or salvage harvests. Recolonize area utilizing natural or artificial regeneration methods.	Prepare NEPA document, implement, and monitor.
Over 85 percent of National Forest System Land is between 60 to 120 years old.	Utilize even-age management techniques to diversify habitat and mast/browse production capability by providing early seral habitat and a wide range of different age classes.	Prepare NEPA document, implement, and monitor.
Commercial timber harvests can improve the health, growth, structure, and diversity of forested land.	Prescribe detailed silvicultural treatments to maintain or improve forest vegetation diversity and wildlife habitat through economically viable commercial timber sales.	Prepare NEPA document, implement, and monitor.
Non-commercial thinning potential exists for young stands clearcut in the 1980s and early 1990s.	Use the crop tree release method to select and release healthy, valuable, and well-formed trees.	Prepare NEPA document, implement, and monitor.
Butternut trees are not as common due to disease.	Locate potentially disease resistant butternut trees and release them from competition. Plant disease resistant butternut trees in suitable regeneration harvest areas.	Prepare NEPA document, implement, and monitor.
Wildlife		
Recent survey information is not available for many species.	Construct and place nest boxes for saw-whet owls, bats, blue birds and wood ducks. Conduct surveys for Management Indicator Species.	Secure funding for surveys. Maintain and monitor nest boxes.
Permanent water sources are lacking in some areas of the watershed.	Create ponds in areas where permanent water sources are scarce.	Prepare NEPA document and monitor.
Grassy wildlife openings are lacking, widely scattered or in inappropriate locations.	Create grassy wildlife openings to diversify habitat. Abandon openings in riparian areas.	Prepare NEPA document and monitor.
Research opportunities exist to improve habitat for West Virginia Northern Flying Squirrels.	Use commercial timber harvests to improve marginal habitat by releasing yellow birch and conifer trees from competition by thinnings. Conduct research study to monitor the effects.	Consult with US Fish & Wildlife Service, obtain incidental take permit, and prepare NEPA document and monitor.

FINDING	**RECOMMENDATION**	**ACTION NEEDED**
Human Uses		
There is a backlog of maintenance on open roads and trails. Many gated roads lack maintenance.	Develop a more comprehensive and frequent maintenance schedule for all specified system roads and trails. Place roads not needed for immediate use into storage by removing culverts.	Maintenance Plans – Monitor.
Pre-historic and historic heritage resource sites provide valuable information of past and reference forest conditions.	Continue to conduct heritage resource surveys to locate pre-historic and historic sites. Seek funding to excavate/evaluate some sites to learn more of past and reference forest conditions.	Prepare NEPA document/work plans to evaluate pre-historic/historic sites. Monitor/protect known sites. Consult with representatives of Native American tribes known to occupy/visit this area.
Artifacts collected from excavated sites need to be stored in an approved facility.	Continue to protect and store collected artifacts in the existing facility.	Maintain/monitor facility.
Some heritage resource sites have been damaged or vandalized.	Maintain confidentiality of known sites.	Protect/monitor known sites.
Illegal ATV/ ORV use is occurring on Forest Service open/ closed roads and trails throughout the watershed assessment area	Identify specific areas where ATV/ ORV use is causing resource damage (such as FR 785, FR785A, and FR 871) and develop a plan to mitigate and rehabilitate those areas	1. Conduct field review, develop action plan, monitor ORV/ ATV activities and prepare appropriate NEPA 2. Increase LEO patrols in the area
A segment of the Chestnut Ridge Trail (TR-327) has numerous washouts and is in overall poor condition.	Rehabilitate/ reconstruct this segment of trail to standard. Consideration should be given to growing mountain bike use within and adjacent to the assessment area	1. Develop rehabilitation plan 2. A Forest-wide Trail Management Plan should be completed.
The McGee Run(TR-328) and Laurel Run (TR-331) Trails are abandoned and are not currently on the Forest Trail System Inventory	Identify any areas of resource concern along these trails and develop mitigation/ rehabilitation/ restoration plans as needed	1. Survey trails to identify any areas of resource concern, Develop action plans as needed. 2. A Forest-wide Trail Management plan should be completed.

FINDING	RECOMMENDATION	ACTION NEEDED
Human Uses (cont.)		
Dispersed recreation sites along within the assessment area are user developed and may or may not be in the most desirable location/ condition.	Survey dispersed recreation sites, identify areas of resource concern and additional/ alternate site locations	Complete dispersed site inventory and action plans/ NEPA as needed
Approximately 39.4 miles of landlines are not surveyed to standard.	Survey remaining landlines to standard to minimize potential trespasses.	Secure funding to complete work.
FR 871 is being used by 4-wheel drive vehicles causing substantial rutting in the road and increasing sediment discharge into Windy Run.	Close road to unauthorized vehicles by blocking entrance at both ends of the road next to private land or abandon the road. Check for access into the Windy Run area by extending FR 233A from Shaver's Fork watershed.	Prepare NEPA document, implement, and monitor.
FR 498 and FR 492 begin on private, cross National Forest System land, and access private cabins. Both roads need maintenance.	Add stone and a sufficient number of properly sized culverts to reduce the amount of sediment entering nearby streams.	Establish cooperative agreement with WV Department of Highways to improve the existing roads.
FR 921 parallels and is in between US highway 250 and FR 92.	Check to see if this road is needed for the Long Term Transportation Plan. Abandon road if not needed or put into storage if needed.	Prepare NEPA document and proceed with abandonment or storage work.

Chapter 6 Team Composition

The core interdisciplinary team for the Upper Tygart Valley Watershed Assessment includes:

Tom Cain – Fisheries Biologist
Glen Juergens – Silviculturist
Michele Jones – NEPA coordinator
Patty McClure – GIS Technician
Ron Polgar – Forestry Technician
Terry Evans – Wildlife Biologist
Jay Vestal - Hydrologist

The extended interdisciplinary team includes:

John Calabrese – Archeologist
Stephanie Connolly – Soils Scientist
Barry Edgerton – Hydrologist
Bob McBride - Silviculturist
Linda Tracy– Geologist
Gene Clare – Geologist Trainee
Don Palmer – Recreation Specialist

APPENDIX A

GLOSSARY

ACRONYMS/ABBREVIATIONS

CODE DESCRIPTIONS

Glossary

Ecosystem – An assembly of living organisms (plants, animals) and non-living components (rocks, soil, water) considered together with their environment.

Riparian Area – A geographically delineable area with distinctive resource values and characteristics, that are comprised of the aquatic and riparian ecosystems, floodplains, wetlands, and adjacent upland slopes. They are three dimensional areas, extending vertically from below the water table to above the canopy of mature site-potential trees; laterally to the estimated boundary of land with direct land-water interactions; and longitudinally up an down streams and along the shore.

Riparian Ecosystem – A transition area between the aquatic ecosystem and the adjacent terrestrial ecosystems, identified by soil characteristics or distinctive vegetation communities that require free or unbound water. Riparian ecosystems extend away from the bank or shore of aquatic ecosystems to include lands with direct land-water interactions that may affect ecological structure, function, and composition.

Watershed – Any land area that forms a basin where runoff from rain and snow melt flow to a common point, such as a stream or lake.

Watershed Assessment (also known as "ecosystem analysis at the watershed scale") – A process conducted by an interdisciplinary team of natural resource specialists to document the processes and interrelationships of a watershed in order to determine its current condition. The purpose being to recommend opportunities for restoration and maintenance needs to enhance or retain biological diversity elements and characteristics.

Acronyms/Abbreviations

ATV- All Terrain Vehicle (4 wheeler)
BBD – Beech Bark Disease
BBS – Breeding Bird Survey
BMP – Best Management Practices
BP – Before present
CMS – Cheat Mountain salamander
CNA – Conditions Not Allowable
CTR – Crop Tree Release
DFC – Desired Future Condition
ELT – Ecological Landtype
Forest Plan – MNF Land and Resource Management Plan
FR – Forest Road
GIS – Geographic Information System
IB – Indiana bat
LTA – Landtype Association
LWD – Large Woody Debris
MIS – Management Indicator Species
MNF – Monongahela National Forest
MP – Management Prescription
NADP – National Atmospheric Deposition Program
NEPA – National Environmental Policy Act
NFS - National Forest System
NFSRP – Northern Flying Squirrel Recovery Plan
NTMB – Neotropical Migratory Bird
OA – Opportunity Area
ORV – Off Road Vehicle
OSR – Overstory Removal
PIF – Partners in Flight
RBC - Running buffalo clover
RCRIS – Resource Conservation and Recovery Information System
RFSS – Regional Forester Sensitive Species List
SMS – Scenic Management System
SWP – Small-whorled pogonia
TES – Threatened/Endangered/Sensitive
T&E – Threatened & Endangered
Tr – Trail
TSI – Timber Stand Improvement
USDA - United States Department of Agriculture
USFWS – United States Fish & Wildlife Service
VBEB – Virginia big-eared bat
WVDEP - West Virginia Department of Environmental Protection
WVDNR – West Virginia Division of Natural Resources
WVGES – West Virginia Geological and Economic Survey
WVNFS – West Virginia Northern Flying Squirrel

Forest Type Code Descriptions

Code	Forest Type
2	Red Pine
5	Hemlock
13	Red Spruce-Balsam Fir
49	Oak-Yellow Pine
52	Chestnut Oak
53	Black Oak-Scarlet Oak-Hickory
54	White Oak
55	Northern Red Oak
56	Yellow Poplar-White Oak-Northern Red Oak
59	Mixed Oaks
81	Sugar Maple-Beech-Yellow Birch
82	Sugar Maple-Basswood
83	Black Cherry-White Ash-Yellow Poplar
85	Sugar Maple
86	Beech
87	Sugar Maple/Beech-Yellow Birch-Red Spruce
88	Black Locust
89	Mixed Hardwoods
92	Birch
98	Upland Brush
99	Open

Size Class Descriptions

Size Class	Description
Open/Brush	Fields presently in grass cover or shrubs such as hawthorn with less than ten percent of the area in forest tree covers.
Seedling/Sapling	A forested stand with the majority of trees smaller than five inches dbh (diameter breast height).
Poletimber	A forested stand with the majority of trees between 5 to 10.9 inches dbh (for hardwood trees) or 5 to 8.9 inches dbh (for conifer trees).
Sawtimber	A forested stand with the majority of trees larger than 11.0 inches dbh (for hardwood trees) or 9 inches dbh (for conifer trees).

APPENDIX B

REFERENCES

References Cited

Adams, M.B., J.N. Kochenderfer, F. Wood, T. Angradi, P. Edwards. 1994. Forty years of hydrometeorological data on the Fernow Experimental Forest, West Virginia. USDA Forest Service, Gen. Tech. Rep. NE-184. NE Forest Exp. Sta., Radnor, PA24 pp.

Adams, M.B., 1999. Acidic deposition and sustainable forest management in the central Appalachians. USA. Forest Ecology and Management. 122. 17-28.

Adams, M.B., Burger, J.A., Jenkins, Zelanzy, L. 2000. Impact of harvesting and atmospheric pollution on nutrient depletion of eastern US hardwood forests. Forest Ecology and Management 138 (2000) p 301-319.

Balcom. B.J. and R.H. Yahner. 1996. Microhabitat and landscape characteristics associated with the threatened Allegheny woodrat. Conservation Biology 10(2):515-525.

Barbour, R. W., and W.H. Davis. 1969. Bats of America. Lexington: Univ. Press of Kentucky. 286 pp.

Berman, G.M., M. Conley-Spencer, and B.J. Howe. 1992. The Monongahela National Forest 1915-1990. West Virginia University Public History Program. Morgantown, WV 248 pp.

Biological Assessment for Threatened and Endangered Species on the Monongahela National Forest, WV. 2000.

Boyle, J.R., and Phillips, J.J., 1973. Whole tree harvesting; nutrient budget evaluation. Journal of Forestry. 71, 760-762.

Brown, H. 2000. Wildland Burning by American Indians in Virginia. USDA Forest Service, Fire Management Today, Volume 60, No. 3, p. 29-39.

Brown, W.F. 1954. History of Nicholas County. The Dietz Press, Inc. Richmond, VA

Buckelew, Jr. A.R. and G.A. Hall. 1994 The West Virginia Breeding Bird Atlas. University of Pittsburgh Press. 215 pp.

Carbone, Victor A. 1976. Environment and Prehistory in the Shenandoah Valley. Unpublished PhD Dissertation, Department of Anthropology, The Catholic University of America, Washington, D.C.

Carvell, K.L. 1986. Effect of Past History on Present Stand Composition and Condition, In: Workshop Proceedings, Guidelines for Managing Immature

Appalachian Hardwood Stands, May 28-30, Morgantown, WV, SAF Pub. 86-02, p. 1-7.

Castleberry, N.L. 2000a. Food habits of the Allegheny woodrat (*Neotoma magister*) in the Ridge and Valley and Allegheny Plateau physiographic provinces of Virginia and West Virginia. M.S. Thesis. West Virginia University, Morgantown, WV. 71pp.

Clark, M.K., and D.S. Lee. 1987. Big-eared Bats, *Plecotus townsendii*, in Western North Carolina. Brimleyana No. 13:137-140.

Clarkson, Roy B. 1964. *Tumult on the Mountain: Lumbering in West Virginia, 1770-1920*. Parsons: McClain Printing Company.

Clarkson, R.B., W. Duppstadt, and R.L. Guthrie. 1980. Forest Wildlife Plants of the Monongahela National Forest. The Boxwood Press, Pacific Grove, CA.

Cusick, A.W. 1989. Trifolum stoniferum *(fabaceae)* in Ohio. History, habits, decline and rediscovery. Sida 13(4): pp. 467-480

Davis, M.B. 1983. Holocene Vegetational History of the Eastern United States. In: Late Quaternary Environments of the United States, Volume II: The Holocene. H.E. Wright, ed., pp. 166-181. Minneapolis: University of Minnesota Press.

Davis, Stephen. 1978. A Cultural Resources Overview of the Monongahela National Forest.

DeHayes, D.H. and G.J. Hawley. 1992. Genetic Implications in the Decline of Red Spruce. Water, Air, and Soil Pollution 62: 233-248.

DeGraaf, R.M., M. Yamasaki, W.B. Leak and J.W. Lanier. 1992. New England Wildlife: Management of Forested Habitats. USDA Forest Service, NEFES, Radnor, PA.

DeGraaf, R.M. and M. Yamasaki. 2001. New England wildlife: habitat, natural history and distribution. University Press of New England, Hanover, NH. 482 pp.

DeMeo, T.E. 1999. Forest songbird abundance and viability at multible scales on the Monongahela National Forest, West Virginia. PhD Dissertation. West Virginia University.

Dolloff, C. Andrew. 1994. Large woody debris—the common denominator for integrated environmental management of forest streams. In: Cairns, John, Jr.; Crawford, Todd V.; Salwasser, Hal, eds. Implementing integrated Environmental

Management. Blacksburg, VA: Center for Environmental and Hazardous Materials Studies, Virginia Polytechnic Institute and State University; 93-108.

Edwards, P. J. and F. Wood, 1994. Centroid Lag Time Changes Resulting from Harvesting, Herbiciding, and Stand Conversion. In: Effects of Human-Induced Changes on Hydrologic Systems. American Water Resources Association. June 1994, pp 727-734.

Endangered Species Federal Assistance Report, Project E-1-11. WV Division of Natural Resources. 1981-1999.

Federer, A.C., Hornbeck, J.W., Tritton, L.M., Martin, C.W., Pierce, R.S., and Smith, C.T., 1989. Long Term Depletion of Calcium and Other Nutrients in Eastern US Forests. Environmental Management. Vol. 13 No. Pp 593-601.

Friedland, A.J., G.J. Hawley, and R.A. Gregory. 1985. Investigations of Nitrogen as a Possible Contributor to Red Spruce (Picea rubens Sarg.) Decline, In: Air Pollutants Effects on Forest Ecosystems, May 8-9, St. Paul, MN. p. 95-106.

Gavin, D. G. and D. R. Peart. 1993. Effects of beech bark disease on the growth of American Beech (*Fagus grandifolia)*. Canadian Journal of Forest Research 23: 1566-1575.

Gilliam and Adams, 1996. Wetfall Deposition and Precipitation Chemistry for a Central Appalachian Forest. Journal of Air and Waste Management Association volume 46: 978-984

Gottschalk, Kurt. 1993. Silvicultural Guidelines for Forest Stands Threatened by the Gypsy Moth. USDA Forest Service General Technical Report NE-171. 50 pp.

Green, N.B. and T.K. Pauley. 1987. Amphibians and reptiles in West Virginia. University of Pittsburgh Press, Pittsburgh, PA. 241 pp.

Grigal, D.F., 2000. Effects of extensive forest management of soil productivity. Forest Ecology and Management 138 (2000) p 167-185.

Hall, George A. 1983. West Virginia Birds Distribution and Ecology. Special publication of Carnegie Museum of Natural History, Pittsburgh, PA. 180 pp.

Harmon, P.J. and D. Mitchell. 1999. Performance Report West Virginia Endangered Plant Species. Statewide Monitoring and Management. WVDNR. Technical Bulletin 99-1. 20 pp.

Hassinger, J. and C. Butchkowski. 1995. Eastern woodrat research/management. 1995. Pennsylvania Game Commission Project Annual Report no. 06718. 5pp.

Head, S. Pers. Comm. 2003. Wildlife Biologist with West Virginia Division of Natural Resources.

Hewlett, J.D. and J.D. Helvey. 1970. Effects of forest clear-felling on the storm hydrograph. Water Resources Research 6:768-782.

Hicks, A. 1989. Whatever happened to the Allegheny woodrat? The Conservationist. March-April:34-38.

Highton, R. 1971. Distributional interactions among eastern North American salamanders of the genus. *Plethodon*. Pp. 139-188. In C. Holt, ed. The distributional history of the biota of the Southern Appalachians. Part III: Vertebrates Virginia Polytechnic Inst. Res. Division Manager. Vol. 4.

Hornbeck, J.W. 1973. Storm flow from hardwood-forested and cleared watersheds in New Hampshire. Water Resources Research 9:346-354.

Hornbeck, J.W., Smith, C.T., Martin, C.W., Tritton, L.M. Perce, R.S., 1990. Effect of intensive harvesting on nutrient capticals of three forest types in New England. Forest Ecology and Management. 30, 55-64.

Hornbeck, J.W., C.W. Martin, and C. Eagar. 1997. Summary of water yield experiments at Hubbard Brook Experimental Forest, New Hampshire. Canadian Journal of Forest Research 27:2043-2052.

Hornbeck, J.W. and J.N. Kochenderfer. 2000. A Century of Lessons About Water Resources in the Northeastern Foresters, In: Proceedings of the Society of American Foresters 2000 National Convention, November 16-20, Washington D.C. SAF publication, SAF 01-02: p. 31-37.

Horsley, S. B., S. L. Stout, and D. S. DeCalesta. 2003. White-tailed Deer Impact on the Vegetation Dynamics of a Northern Hardwood Forest. Ecological Applications. 13(1), 2003, pp. 98-118.

Houston, D. R. and J. T. O'Brien. 1983. Beech Bark Disease. USDA Forest Service, Forest Insect & Disease Leaflet No. 75. 8 pp.

Hunter, Malcolm L. 1990. Wildlife, Forests, and Forestry Principles of Managing Forests for Biological Diversity. Englewood Cliffs, New Jersey: Prentice Hall, Inc.

Hutchinson, S. F. 1995. 1995 Wooly Adelgid Surveys. WV Department of Agriculture. Unpublished report.

Johnson, A.H., Anderson, S.B., and Siccama, T.G., 1994a, Acid rain and soils of the Adirondacks. I. Changes in pH and available calcium: Canadian Journal of Forest Research, v. 24 p. 193-198.

Johnson A.H., Friedland, A.J., Miller, E.K., and Siccama, T.G., 1994b, Acid rain and soils of the Adirondacks. III. Rates of soil acidification in montane spruce-fir forests at Whiteface Mountain, New York: Canadian Journal of Forest Research, b. 24, p. 663-669.

Johnson, C.E., Romanowicz, R.B., Siccamam, T.G., 1997. Conservation of exchangeable cations after clear-cutting of a northern hardwood forest. Canadian Journal of Forest Resources. 27, 859-868.

Johnson, D.W., Todd, D.E., 1998. Harvesting effects on long-term changes in nutrient pool of mixed oak forest. Soil Science Society of America Journal. 62, 1725-1735.

Kajawski, R. 1998. Biological Control of Hemlock Wooly Adelgid. City Trees: The Journal of The Society of Municipal Arborists, January/February, 1998. p. 17.

Kellog, R. 1937. Annotated list of West Virginia mammals. Proc. U.S. Nat. Mus. (Smithsonian Institution) 84(3022):443-479.

Kirkland, G.L., Jr., and F.J. Jannett, Jr. 1982. *Microtus chrotorrhinus*. Mammalian Species No. 180. 5 pp.

Knoepp, J.D., and Swank, W.T., 1997. Long-term effects of commercial sawlog harvest on soil cation concentrations. Forest Ecology and Management. 93, 1-7.

Kochenderfer, J. N., P. J. Edwards, and F. Wood. 1997. Hydrologic Impacts of Logging An Appalachian Watershed Using West Virginia's Best Management Practices. Northern Journal of Applied Forestry 14(4): 207-218.

Kramer, P., N. Reichenbach, M.Hayslet and P. Sattler. 1993. Population dynamics and conservation of the Peaks of Otter salamander, Plethodon hubrichti. J. Herpetol. 27(4); 431-435.

Kuhlman, E.G. 1978. The Devastation of American Chestnut by Blight. In: Proceedings of the American Chestnut Symposium, January 4-5, 1978, Morgantown, WV. p. 1-3.

Leak, W. B. and M-L. Smith. 1996. Sixty Years of Management and Natural Disturbance in a New England Forested Landscape. Forest Ecology and Management 81: 63-73.

Lewis, R. L. 1998. Transforming the Appalachian Countryside: Railroads,

Deforestation, and Social Change in West Virginia, 1880-1920. The University of North Carolina Press, Chapel Hill, NC. 348 pp.

Litvaitis, J.A. 1993. Response of early successional vertebrates to historic changes in land use. Conservation Biology 7: 866-873

MacDonald, W. L., Cech, F. C., Luchok J., and Smith, C. 1978. In: Proceedings of the American Chestnut Symposium, January 4-5, 1978, Morgantown, WV. 122 pp.

Markewitz, D., Richter, D.D., Allen, H.L. and Urrego, J.B., 1998, Three decades of observed soil acidification in the Calhoun Experiemntal Forest: Has acid rain made a difference?: Soil Science Society of America Journal, v. 62, p. 1428-1439.

McKeever S. 1952. A survey of West Virginia Mammals. Conservation Commission of WV, Charleston, WV. 179 pp.

McManus, M., N. Schneeberger, R. Reardon, and G. Mason. 1989. Gypsy Moth. USDA Forest Service, Forest Insect & Disease Leaflet No. 162. 13 pp.

McShea, W.V. and W.M. Healy, eds. 2002. Oak Forest Ecosystems Ecology and Management for Wildlife. The Johns Hopkins University Press.

Medville, DM and H.E. Medville. 1995. Caves and karst of Randolph County. West Virginia Speleological Survey Bulletin 13. WV Speleological Survey. Barrackville, WV.

Mengak, M.T. 1996. Small mammal investigations: woodrat studies. Virginia Department of Game and Inland Fisheries Performance Report. 10 pp.

Miller, H.A. and S.H. Lamb. 1985. In: Oak Forest Ecosystems, Ecology and Management for Wildlife, edited by W.J. McShea and W.M. Healy. 2002. The Johns Hopkins University Press, Baltimore, MD.

Millspaugh, C.F. 1891. In: Upland Forests of West Virginia, edited by Steven L. Stephenson. 1993. McClain Printing Co., Parsons, WV

Montgomery, M. E. and S. M. Lyon. 1996. Natural Enemies of Adelgids in North America: Their Prospect for Biological Control of *Adelges tsugae* (*Homoptera: Adelgidae*), In: Proceedings of the First Hemlock Wooly Adelgid Review, October 12, 1995, Charlottesville, VA, p. 89-102.

Morrison, I. K. 1984. Acid Rain: A Review of the Literature on Acid Deposition Effects in Forest Ecosystems. Commonwealth Agriculture Bureau 45 (8) p. 483 - 506.

NAPAP (National Atmospheric Precipitation Assessment Program), 1998. Report to Congress. Washington, D.C.

National Weather Service. 2002. http://www.erh.noaa.gov/er/rlx/climate.

Newhouse, J. R. 1990. Chestnut Blight. Scientific American, July 1990. p. 106-110.

Ostlie, W. 1990. Element stewardship abstract for *Trifolium stoloniferum*, Running Buffalo Clover. The Nature Conservancy, Minneapolis, MN. 18 pp.

Ostrofsky, W. D. and D. R. Houston. 1988. Harvesting Alternatives for Stands Damaged by the Beech Bark Disease, In: Proceedings of the 1988 Society of American Foresters National Convention, October 16-19, Rochester, NY, p. 173-177.

Ostry, M. E. 1997. Butternut Canker in North America 1967-1997. In: Proceedings of the IUFRO WP 7.02.02 Meeting, May 25-31, 1997, Quebec City, Canada, p. 121-128.

Pashley, D.N., C.J. Beardmore, J.A. Fitzgerald, R.P. Ford, W.C. Hunter, M.S. Morrison, and K.V. Rosenburg. 2000. Partners in Flight: Conservation of the land birds of the United States, American Bird Conservancy, 92 pp.

Patric, J. H. 1984. Some Environmental Effects of Cable Logging in the Eastern Hardwoods. In: Mountain Logging Symposium Proceedings, June 5-7, 1984, West Virginia University, p.99-105.

Pauley, B.A. and T.K. Pauley. 1997. Range and distribution of the Cheat Mountain salamander, *Plethodon nettingi*: an update. Proc. W. Virginia Acad. Sci. 69 (1):3.

Pauley, T.K. 1991. Cheat Mountain Salamander (*Plethodon nettingi*) Recovery Plan. U.S. Fish and Wildlife Service; Northeast Region, Newton Corner, MA. 31 pp.

Pauley, T.K.. 1999. Personal communication. Professor of Herpetology, Marshall University, Huntington, WV.

Peacock, Evan. 1998. Historical and Applied Perspectives on Prehistoric Land Use In Eastern North America. Environment and History 4 (1998) p. 1-29.

Pimentel, D., L. Lach, R Zuniga, and D. Morrison. 1999. Environmental and Economic Costs with Non-Indigenous Species in the United States. Unpublished Paper. Cornell University. 23 pp.

Reardon, R. and A. Hajek. 1998. The Gypsy Moth Fungus *Entomophaga maimaiga* in North America. USDA Forest Service, Forest Health Technology Enterprise

Team, Morgantown, WV, FHTET-97-11, 22 pp.

Reger, David B. 1931. West Virginia Geological Survey Randolph County. West Virginia University, Morgantown, WV 989 pp.

Reinhart, K.G., A.R. Eischner, and G.R. Trimble, Jr. 1963. Effect on streamflow of four forest practices in the mountains of West Virginia. USDA Forest Service Research Paper NE-1. 79 pp.

Richter, D.D., Markewitz, D., Wells, and others. 1994. Soil chemical change in an old-field loblolly pine ecosystem: Ecology, v. 75, p. 1463-1473.

Romme, R.C., K. Tyrell and V. Brack. 1995. Literature Summary and Habitat Suitability Index Model: Components of summer habitat for the Indiana Bat, Myotis sodalis. Federal and Project E-1-7, Study No 8. 3ID Environmental. 38 pp.

Schlarbaum, S.E. 1989. Returning the American Chestnut to Eastern North America, In: Workshop Proceedings, Southern Appalachian Mast Management, August 14-16, Knoxville, TN, p.66-70.

Southern Appalachian Man and the Biosphere. 1996. The Southern Appalachian Assessment Summary Report. Report 1 of 5. Atlanta: USDA Forest Service, Southern Region.

Souto, D., Luther, T., and Chianese, B. 1995. Past and Current Status of HWA in Eastern and Carolina Hemlock Stands, In: Proceedings of the First Hemlock Wooly Adelgid Review, October 12, Charlottesville, VA, p. 9-15.

Stauffer Jr., Jay R., Jefferey M. Boltz and Laura R. White, 1995. The Fishes of West Virginia. Reprinted from the Proceedings of the Academy of Natural Sciences of Philadelphia 146:1-389 (1995).

Stephenson, S.L. and J.F. Clovis. 1983. In: Upland Forests of West Virginia, edited by Steven L. Stephenson. 1993. McClain Printing Co., Parsons, WV.

Stephenson, S.L. 1993. Upland Forests of West Virginia. McClain Printing Co., Parsons, WV

Stihler, C.W. 1996. A summer bat survey near Big Springs Cave on the Fernow Experimental Forest, Tucker County, West Virginia. Report submitted to the U.S. Forest Service, Northeastern Forest Experiment Station. 18 pp.

Stihler, C.W. 2000. Personal communication. Endangered Species Biologist, WVDNR, Elkins, WV.

Stihler, C.W., J.L. Wallace, and W.R. McClain. 2000. Endangered Species Federal Assistance Performance Report, Project E-1-11. WVDNR 76 pp.

Strausbaugh, P.D. and E.L. Core. 1977. Flora of West Virginia, Second Edition. Seneca Books, Inc., Grantsville, WV.

Tetra Tech Inc. 2000. A Stream Condition Index for West Virginia Wadeable Streams. Prepared for U.S. EPA Region III, Office of Water: Science and Technology Division.

USDA. Forest Service. 1975. Experimental Planting in Cutover Spruce-Fir in the Southern Appalachians: 50 Year Results. Southeastern Forest Experiment Station Research Note SE-219. Asheville, NC. 5 pp.

USDA Forest Service. 1986. Final environmental impact statement and land and resource management plan. Monongahela National Forest, Elkins, WV.

USDA Forest Service. 1995. Monongahela National Forest Sensitive Plant Species Guide. Monongahela National Forest, Elkins, WV.

USDA Forest Service. 2000. Watershed analysis report for the Upper Williams River watershed. Marlinton Ranger District, Monongahela National Forest.

USDA Forest Service. 2002. Southern Forest Resource Assessment. General Technical Report GTR SRS-53. Southern Reseach Station, Asheville, NC. 635 pp.

USDA Forest Service. 2002. Pest Alert: Emerald Ash Borer. NA-PR-07-02. Northeastern Area State and Private Forestry, Newtown Square, PA. 3 pp.

USDA Forest Service. June 2002. FSH 2509.18 Soil Management Handbook. R9 Supplement. Chapter 2, Soil Quality Monitoring. Final Draft.

USDA Natural Resource Conservation Service, Forest Service, in Coopearation with West Virginia University Agricultural Extension Service, and Pocahontas County Commission. 1998. Soil Survey of Pocahontas County, West Virginia.

USDA Soil Conservation Service and Forest Service in Cooperation with West Virginia University Agricultural Extension Service. 1982. Soil Survey of Randolph County Area, Main Part, West Virginia.

U.S. Fish and Wildlife Service, 1982. Habitat Suitability Index Models: Brook Trout. Biological Services Program and Division of Ecological Services, FWS/OBS-82/10.24, September, 1982. 44 pp.

U.S. Fish and Wildlife Service. 1990. Appalachian Northern Flying Squirrels (*Glaucomys sabrinus fuscus* and *Glaucomys sabrinus* coloratus) Recovery Plan. Newton Corner, Massachusetts. 53 pp..

U.S. Fish and Wildlife Service. 1996. Preliminary Revised Draft Recovery Plan for the Indiana Bat. 31 pp.

U.S. Fish and Wildlife Service. 2002. Biological Opinion for the Monongahela National Forest.

U.S. Forest Service Unpublished Report, 1994. Fisheries Input For Opportunity Areas 36.116, 36.117, and 36.118. Prepared by Karen Barton, March 1, 1994. On file at the Monongahela National Forest Supervisor's Office, Elkins, WV.

USGS, 1999. Soil-Calcium Depletion Linked to Acid Rain and Forest Growth in the Eastern United States. US Department of Interior, Washington, D.C.

Wallace, V. March and October 1999. Personal Communication. Wildlife Biologist, WVDNR, Elkins, WV.

Weetman, G.E., Webber, B., 1972. The influence of wood harvesting on the nutrient status of two spruce stands. Canadian Journal of Forest Resources. 2, 351-369.

West Virginia Department of Environmental Protection 2002. Draft 2002 303(d) List. http://www.dep.state.wv.us/item.cfm?ssid=11&ss1id=188

West Virginia Department of Environmental Protection 2003. WVDEP, Division of Water and Waste Management web site. http://www.dep.state.wv.us/item.cfm?ssid=11&ss1id=197

West Virginia Division of Natural Resources. 1990. Small Game Bulletin.

West Virginia Division of Natural Resources. 1999. Performance Report West Virginia Acid Water Studies, Chemical Investigations of Acid Precipitation Impacted Trout Stream. Technical Bulletin 99-4.

West Virginia Division of Natural Resources. 2001. Big Game Bulletin. Wildlife Resources Section Bulletin 02-4

West Virginia Division of Natural Resources. 2002. Big Game Bulletin.

Whitaker, Jr., J.O., and W.J. Hamilton, Jr. 1998. Mammals of the eastern United States, Third Edition. Cornell University Press., Ithaca, NY. 583 pp.

Wilson, D.E. and S. Ruff. 1999. The Smithsonian book of North American mammals. Smithsonian Institution Press, Washington, D.C. 750 pp.

Wilkins, Gary R. 1977. Cultural Ecology of Prehistoric Mountaintop Sites in the Kanawha Basin, West Virginia. Unpublished MA Thesis, Department of Anthropology, University of Arkansas, Fayetteville, Arkansas.

APPENDIX C

Likelihood of Occurrence Table

Endangered, Threatened, and Sensitive Species

Likelihood of Occurrence
Upper Tygart Valley Watershed Assessment

12/30/2003

Threatened / Endangered	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
Mammals					
Gray wolf	Canis lupus	LE/GE/N4/SX	High spruce forest and associated northern mixed hardwood/coniferous forest. Considered extirpated from WV since 1900 when the last wolf was killed in the state.[1, 41]		Considered extirpated from WV.[1, 41]

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
Virginia big-eared bat	*Corynorhinus townsendii virginianus* LE/G4T2/N2/S2	Uses caves during summer (maternity sites) and winter (hibernacula). These caves are typically located in karst regions dominated by oak-hickory or beech-maple-hemlock forest associations. Forage in patchy mosaic habitats[3, 45] Cave Mountain cave (Pendleton Co.) and Cave Hollow/Arbogast cave (Tucker Co.) have been designated as Critical Habitat by USFWS. "Significant" status is based on Federal Caves Resources Protection Act of 1988. Forest Plan amendment calls for creation of MP 837 for areas 200' from VBEB caves. Reference Forest Plan Amendment. There have been no summer captures of VBEB's during mist netting within this watershed.			

Cave Name	Cave Status	Approximate Miles to watershed	Ownership	Quad
Alpena #1	Extirpated from this cave, within proclamation boundary	17.25	Private	Bowden
Alpena #2	Extirpated from this cave, within proclamation boundary	16.68	Private	Bowden
Aqua-terra	within proc boundary, hibernacula	14.68	Private	Whitmer
Big Springs	Gated, significant, hibernacula	21.70	FS	Parsons
Bowden	Significant, hibernacula	14.65	Private/FS	Bowden
Brook Stemple	Historical, within 5 miles of Proc boundary	41.62	Private	Aurora
Cave Hollow/Arbogast	Critical, gated, significant, hibernacula, maternity	23.66	FS	Mozark
Cave Mountain	Gated, significant, critical, maternity	33.85	FS	Upper Tract
Cedar Hill	Historical	40.62	Private	Petersburg West
Flute	Transient colony	28.61	Private	Sugar Grove
Gale Warner	Maternity cave	25.12	Private	Circleville
Harper Trail	Hibernacula	5.60	FS	Beverly East
Hellhole	Critical, fenced, within proc boundary	27.01	Private	Onego
Izaak Walton	Within proc boundary	6.09	Private	Beverly East
Keys		28.85	Private	Franklin
Mill Run #1	Signed, within proc boundary	36.22	Private	Hopeville
Mill Run #2	Signed, within proc boundary	35.89	Private	Hopeville
Minor Rexrode	Gated, fenced, maternity and hibernacula, outside proc boundary	28.94	Private	Sugar Grove
Mystic	Signed, maternity, within proc boundary	27.41	Private	Onego
New Trout	Hibernacula	27.91	Private	Sugar Grove
Peacock	Signed, maternity, hibernacula, within proc boundary	38.79	Private	Petersburg West
Rexrode	Historical	25.56	Private	Moatstown
Schoolhouse	Fenced, gated, maternity, within proc boundary	28.47	Private	Upper Tract
Seneca Caverns	Within proc boundary	27.05	Private	Onego
Sinks of Gandy	Within proc boundary	12.89	Private	Sinks of Gandy
Sites	Historical	30.51	Private	Sugar Grove
Smoke Hole	Maternity, within proc boundary	33.36	Private	Upper Tract
Stewart Run		Within WS	Private	Snyder Knob
Trout	Within 5 miles of Proc boundary	29.02	Private	Sugar Grove
Warners	Historical	27.36	Private	Onego

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
Eastern cougar	*Puma concolor couguar*	LE/G5TH/NH/SH	Very large, remote, undisturbed, mountainous areas. Hardwood or mixed forest.	Presence in West Virginia is unconfirmed at this time. [1, 41] The last documented eastern cougar is one shot in Pendleton Co. in 1887 but as late as 1936 there were reported tracks in Pocahontas Co. [41]	Presence in West Virginia is unconfirmed at this time. [1, 41]
WV northern flying squirrel	*Glaucomys sabrinus fuscus*	LE/G5T2/N2/S2	Associated with boreal habitats, especially spruce-fir and northern hardwood forests. Elevations from 2600-4600'. Northern hardwood forests that contain a conifer component. [2, 26, 45]	Extends southwestward, following the Allegheny Mt., from Canaan Heights and the northwestern edge of the Dolly Sods Wilderness Area (Tucker Co.) in the north to Briery Knob (Pocahontas Co.) and Rabbit Run (Greenbrier Co.) in the south. Also encompassing areas in Randolph, Webster, and Pendleton Co.	WVNFS captures occur in two areas of the Upper Tygart watershed.

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
Indiana bat	*Myotis sodalis*	LE/G2/N2/21	Winter in caves or mines that satisfy their highly specific need for cold temperatures during hibernation. During summer, roost in trees and forage primarily in riparian and upland forests.[4, 45] Cave Hollow/Arbogast cave (Tucker Co.) has been designated as Critical Habitat by USFWS. "Significant" status is based on Federal Caves Resources Protection Act of 1988. Forest Plan amendment calls for Indiana bat habitat to be designated MP 838. Reference Forest Plan Amendment. Three Indiana bats have been found within the watershed boundary, not on Forest Service.		

Cave Name	Cave Status	Approximate miles to watershed	Ownership	Quad
Big Springs	Gated, significant	21.7	FS	Parsons
Bob Gee	Within proclamation boundary	37.36	Private	Trout
Bowden	Significant	14.65	Private	Bowden
Cass	Within proclamation boundary	3.0	Private	Cass
Cave Hollow/Arbogast	Critical, Gated, significant	23.66	FS	Mozark
Coal Run		23.38	Private	Mozark
Falling Spring	Within proclamation boundary	1.40	Private	Mingo
Fortlick	Within 5 miles of Proc boundary	Within WS	Private	Valley Head
Gooseberry (2 entrances)	Within 5 miles of Proc boundary	Within WS	Private	Adolph
Hellhole	Critical, Within proc boundary	27.01	Private	Onego
Higginbotham's #1 - #4	Within 5 miles of Proc boundary	40.60	Private	Williamsburg
Izaak Walton	Within proclamation boundary	6.09	Private	Beverly East
Lobelia Saltpeter	Within 5 miles of Proc boundary	37.73	Private	Lobelia
Martha's	Within 5 miles of Proc boundary	24.27	Private	Hillsboro
Schoolhouse	Within proclamation boundary	28.47	Private	Upper Tract
Simmons Mingo (2 entrances)	Within proclamation boundary	Within WS	Private	Mingo
Smoke Hole	Within proclamation boundary	33.08	Private	Upper Tract
Snedegers	Restricted access	28.59	Private	Droop
Stewart Run	Within proclamation boundary	Within WS	Private	Snyder Knob
Trout	Within 5 miles of Proc boundary	29.02	Private	Sugar Grove
Tub	Within 5 miles of Proc boundary	17.14	Private	Hillsboro
Two Lick Run	Signed, significant	17.76	FS	Bowden
Upper Martha's	Within 5 miles of Proc boundary	24.44	Private	Hillsboro

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
Birds					
Bald Eagle	*Haliaeetus leucocephalus*	LT/G4/N4B,N4N/ S2B,S2N	Typically found along the shores of large rivers and lakes, as main prey is fish and waterfowl. Nests in tall trees or on cliffs near large rivers or lakes. [6]	Grant, Hampshire, Mineral and Hardy Co. Migratory routes traverse areas of the MNF Ranger Districts.	No records of Bald eagles nesting within watershed.
Amphibian					
Cheat Mountain Salamander	*Plethodon nettingi*	LT/G2/N2/S2	Moist spruce or mixed spruce/deciduous forests, including, but not limited to, shaded or moist coves, possibly with rhododendron and/or small emergent rocks within spruce or hemlock forest. Spruce stands containing Bazzania (a liverwort).[7]	Minimum elevation is 2600' on the Cheat district, and 2940' on the Potomac and Greenbrier districts. Range extends east of McGowan Mt. (Randolph Co.) to Dolly Sods (Tucker Co.), south to Spruce Knob (Pendleton & Pocahontas Co.), southwest to Thorny Flat (Pocahontas Co.), north to Barton Knob (Randolph Co.). Not known to occur on the Gauley, Marlinton, or White Sulphur districts.	There are several known sites within the watershed. Population boundaries have not been delineated, therefore surveys will be required prior to activity.
Reptiles & Fish					
None					
Plants					
Small-whorled pogonia	*Isotria medeoloides*	LT/G2/N2/S1	Mixed deciduous or mixed-deciduous/coniferous forest in generally second or third growth successional stages; occurs in both fairly young forests and in maturing stands. Majority of occupied sites have: sparse to moderate ground cover; relatively open understory, proximity to logging roads, streams or other features that create long persisting breaks in canopy; associated species -- witch-hazel, striped maple, hazelnut, serviceberry; highly acidic nutrient-poor soil.[17]	Occurs on only one known site in WV in Greenbrier County, White Sulphur District	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time. Surveys will be completed prior to activity.
Shale Barren Rockcress	*Arabis serotina*	LE/G2/N2/S2	Biennial herb found mostly on shale barrens of eastern counties of WV.[8]	Grant, Greenbrier, and Pendleton counties.	No suitable habitat within watershed.
Virginia Spirea	*Spiraea virginiana*	LT/G2/N2/S1	Clonal shrub found on damp, rocky banks of larger high gradient streams. Flood-scoured mouths of side streams, rocky isles, and seasonally	Known from Greenbrier Co. near Greenbrier Youth Camp; National Park Service land in Nicholas Co.	Based on habitat requirements and presence of suitable habitat, species could

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
			flooded side channels, in shrub thickets between the river and forest. Full sun or shade. [9]		occur, however, presence is unconfirmed at this time. Surveys will be completed prior to activity.
Running Buffalo Clover	*Trifolium stoloniferum*	LE/G3/N3/S2	Perennial clover found on rich, fertile (limestone geology & soils), semi-shaded habitats. Open, savannah-like forests; lightly disturbed areas such as old logging roads. Also old farmsteads and cemeteries. [9]	Logging roads on the Fernow Experimental Forest; Swecker Ridge, McGowan Mt., Cheat Mt. (Chestnut Ridge), Shavers Fork (Randolph and Tucker Co.). Also found in Greenbrier and Pendleton Co.	Present within watershed. Surveys will be completed prior to activity.
Sensitive Species					
Mammals					
Southern rock vole	*Microtus chrotorrhinus carolinensis*	G4T3/N3/S2 (SOC)	Moist rocky areas or mossy rocks and logs in spruce & mixed deciduous-coniferous forests [48], often with birch, other hardwoods & hemlock components. Dense ground cover of mosses, ferns, & northern herbs. Unvegetated talus, grass balds, recent clearcuts, & road-fills. Highly associated with surface or subsurface water.[10, 48]	Tucker, Randolph, Pendleton, Pocahontas, & Greenbrier Co.	Present within watershed. Suitable habitat is found within the watershed.
Eastern small-footed bat	*Myotis leibii*	G3/N3/S1(SOC)	Hibernates in caves, sometimes under stones or in deep crevices. Summer roosts and maternity sites in buildings, caves, rock crevices, tunnels or under bridges. It is thought that rock outcrops are important for this species. Forages over ponds and streams. Summer habitat may or may not be in proximity to hibernation sites. [11, 42]	Preston, Tucker, Grant, Randolph, Pendleton, Pocahontas, and Greenbrier Co.	Present within watershed. Suitable habitat is found within the watershed**.**
Allegheny woodrat	*Neotoma magister*	G3G4/N3N4/S3 (SOC)	Extensive rocky areas in deciduous or mixed forests, outcrops, cliffs, rocky talus slopes, caves, riverbanks with sandstone rocks and boulders[12] and buildings[47, 45].	Widespread across the Monongahela in rocky areas and around many caves	Present within watershed. Suitable habitat is found within the watershed.
Southern water shrew	*Sorex palustris punctulatus*	G5T3/N3/S1 (SOC)	Found near streams or other bodies of water. Heavy vegetative cover and	Preston, Tucker, Randolph, Pendleton, and Pocahontas Co.	Based on habitat requirements and

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
			plentiful logs, rocks, crevices, or other sources of shelter that offer high humidity and overhead protection [47]. Dominant trees often yellow birch and red maple with dense rhododendron and laurel understory. [13]		presence of suitable habitat, species could occur, however, presence is unconfirmed at this time
Birds					
Northern Goshawk	*Accipiter gentilis*	G5/N4B,N4N/ S1B,S1N(SOC)	Coniferous, deciduous, & mixed forests; utilizes a variety of forest types, structural conditions, and successional stages. Usually nests in trees greater than 12" DBH. WV is on the southern extent of range. [15, 21]	Pocahontas, Randolph, Webster, Tucker Co. They also may be found nesting at elevations above 2500-3000 feet in Grant, Greenbrier, Mineral, Nicholas, and Preston Co.	Suitable habitat is found within the watershed. Surveys have been completed, no nests were found.
Peregrine falcon	*Falco peregrinus anatum*	G4T3/N3B,N3N	Nest sites on cliffs, prominent high spots, buildings and bridges. Needs isolation from human disturbance. [5]	Historic nest sites in Grant, Pendleton, and Greenbrier Co. Known nests found on North Fork Mountain and Gauley Gorge.	No suitable habitat is found within the watershed.
Migrant Loggerhead shrike	*Lanius ludovicianus migrans*	G4T3Q/N3B,N3N/ S1B,S1N	Most numerous in dry, open, eastern valleys (Shenandoah Valley). Prefers open farm and pasture, usually perching on scattered trees or wires. Favored nesting site: dense brush, most often with thorn trees. [21, 22]	May be found almost any summer in Hampshire, Grant, Pendleton, Greenbrier, and Monroe Co. Rare and local in Nicholas, Pocahontas, Tucker, and Hardy Co. Confirmed nesting in Berkley, Grant, Greenbrier, Monroe, and Mercer Co. [21]	Suitable habitat is found within the watershed. Breeding bird surveys have been completed, no individuals were identified.
Reptiles					
Timber rattlesnake	*Crotalus horridus*	G4/N4/S3	Rough mountainous terrain where brushy ridges and rocky hillsides with ledges abound. Common in wooded areas, but may occur in valleys, along streams and among slab piles around old sawmill sites. [17]	In WV, range extends from the Eastern Panhandle across the Alleghenies south into Mercer and Mingo counties.	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Amphibians					
Green	*Aenides aeneus*	G3G4/N3N4/S3	Smaller deeper crevices in rock faces,	Droop Mtn.; Blackwater Falls	Present within

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
salamander		(SOC)	well-shaded and moist, but not wet, or under bark on trees, rotting logs, etc. Usually below 3000' in northern MNF; below 3500' in southern MNF. [17, 23]	State Park; Tucker, Pocahontas, Randolph, Webster, and Nicholas Co. [30]	watershed. Suitable habitat is found within the watershed.
Hellbender	*Cryptobranchus alleghaniensis*	G3G4/N3N4/S2 (SOC)	Cool, clear, larger permanent streams. Found throughout the Ohio River drainage. They spend most of their time under flat rocks, emerging at night to forage for food. [17, 23]	Tucker, Randolph, Pocahontas, Webster, Nicholas, and Greenbrier Co.	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Fish					
Redside dace	*Clinostomus elongatus*	G4/N4/S1S2	Clear, cool streams, in small pools or backwater areas; most often found over gravel or cobble substrates and not typically found in association with aquatic vegetation. Found in the Monongahela River basin, the upper main channel of the Ohio River, and Middle Grave Creek; patchily distributed and uncommon.	Species has not been taken within MNF boundaries. The closest known localities are from Blackwater River above the falls (i.e. Canaan Valley), and Laurel Creek in Preston Co. [24, 25]	Not known to occur within watershed based on known range and occurrences.
Candy darter	*Etheostoma osburni*	G3/N3/S3(SOC)	Occupies rocky riffles, appears to be most common in cool to cold sections of moderate to small streams. Widely distributed, locally common endemic of lower New River drainage. [49, 18]	Gauley & New River drainages.	Not known to occur within watershed based on known range and occurrences.
Pearl dace	*Margariscus margarita*	G5/N5/S3S4	Small, clear, cold streams; often near springs over fine gravel substrates [49]; frequently occupies bogs and ponds created by beaver dams.	In WV restricted to the Potomac and Monongahela Rivers; most abundant in Shavers Fork of the Cheat River and the two eastern-most tributaries of the Potomac River.[25]	Not known to occur within watershed based on known range and occurrences.
New River shiner	*Notropis scabriceps*	G4/N4/S2	Pools or slow runs in small or medium-sized streams, usually over bedrock or gravel substrates.	An endemic species with patchy distribution in the northern tributaries of the New River and definitely located within boundaries of the MNF. Has almost disappeared from the Gauley River drainages, but can still be found in the eastern tributaries. Is still fairly common	Not known to occur within watershed based on known range and occurrences.

<table>
<tr><th></th><th>Scientific Name</th><th>Species Rank</th><th>Habitat</th><th>MNF Range</th><th>Likelihood of Occurrence</th></tr>
<tr><td></td><td></td><td></td><td></td><td>in the Greenbrier River waters. [24, 25]</td><td></td></tr>
<tr><td>Appalachia darter</td><td>Percina gymnocephala</td><td>G4/N4/S3</td><td>Pools and runs of mid-sized to large streams and rivers.</td><td>New River, Greenbrier and Gauley Rivers, East Fork of the Greenbrier River and Laurel Creek, Gauley drainage. [25]</td><td>Not known to occur within watershed based on known range and occurrences.</td></tr>
<tr><td>Kanawha minnow</td><td>Phenacobius teretulus</td><td>G3G4/N3N4/S1 (SOC)</td><td>Endemic to New (upper Kanawha) River drainage. Juveniles and adults typically occupy riffles and runs of gravel, rubble and boulder in cool to warm medium to large streams [49]. Apparently has a preference for soft water [19].</td><td>Upper Gauley River & New River tributaries. Pocahontas, Webster and Greenbrier Counties. May only inhabit the east and west forks of the Greenbrier River.</td><td>Not known to occur within watershed based on known range and occurrences.</td></tr>
<tr><td>Cheat minnow</td><td>Pararhinichthys bowseri</td><td>G1G2Q/N1N2/ S1S2(SOC)</td><td>Most often found in deep runs over gravel/rubble substrate.[20]</td><td>Found only in the Monongahela River drainages of the Ohio River Basin in WV and in waters on the Appalachian Plateau and Allegheny Mt. Provinces.</td><td>Not known to occur within watershed based on known range and occurrences.</td></tr>
<tr><td colspan="6">Mollusks</td></tr>
<tr><td>Elktoe</td><td>Alasmidonta marginata</td><td>G4/N4/S2(SOC)</td><td></td><td>Present in Greenbrier River, Cloverlick down through Hosterman to the mouth of the Greenbrier and into the New River.</td><td>Not known to occur within watershed based on known range and occurrences.</td></tr>
<tr><td>Organ cavesnail</td><td>Fontigens tartarea</td><td>G2/N2/S2</td><td>Inhabits cave streams under flat rocks.[43,30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Bazzle</td><td>Private</td><td>Harman</td></tr>
<tr><td>Bowden</td><td>FS</td><td>Bowden</td></tr>
<tr><td>Bowden/Bear Heaven</td><td>FS</td><td>Bowden</td></tr>
<tr><td>Dreen</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Harper</td><td>Private</td><td>Mozark Mt.</td></tr>
<tr><td>Martha’s</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>Piddling Pit</td><td>Private</td><td>Edray</td></tr>
<tr><td>Simmons-Mingo</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Swecker Stream</td><td>Private</td><td>Mingo</td></tr>
</table></td><td></td><td>Present within watershed. Suitable habitat is found within the watershed.</td></tr>
<tr><td>Green floater</td><td>Lasmigona subviridis</td><td>G3/N3/S2(SOC)</td><td>Fine gravel and sand in backwater and slower water. Patchy occurrence in small to large rivers away from fast current and large boulders.</td><td>Currently in Greenbrier River & Clover Creek. Past record from New River drainage. Any Greenbrier River tributary is potential habitat. Two sites on west fork of Greenbrier above</td><td>Not known to occur within watershed based on known range and occurrences.</td></tr>
</table>

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<tr><th></th><th>Scientific Name</th><th>Species Rank</th><th>Habitat</th><th>MNF Range</th><th>Likelihood of Occurrence</th></tr>
<tr><td></td><td></td><td></td><td></td><td>Durbin. From Cass south on Greenbrier is good potential.[14, 26]</td><td></td></tr>
<tr><td colspan="6">Insects</td></tr>
<tr><td>A cave beetle</td><td>Pseudanophthalmus fuscus</td><td>G2G3/N2N3/S2</td><td>Usually near damp or wet places under rocks or rotting wood near cave streams.[35,30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Blue Springs</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>Bolling</td><td>Private</td><td>Denmar</td></tr>
<tr><td>Fox</td><td>Private</td><td>Droop</td></tr>
<tr><td>Higginbotham’s</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>McClung</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Piddling Pit</td><td>Private</td><td>Edray</td></tr>
</table></td><td></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>Timber Ridge cave beetle</td><td>Pseudanophthalmus hadenoecus</td><td>G1/N1/S1</td><td>Twilight zone or deeper in caves; on moist soil, often near streams or drip areas. Probably do burrow some; often found under rocks or debris. [31]</td><td>Occurs in Mystic Cave, Pendleton Co., Onego Quad (right on Proclamation Boundary). [30]</td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>A cave beetle</td><td>Pseudanophthalmus hypertrichosis</td><td>G3/N3/S3</td><td>Damp clay banks in caves. [43,30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Arbuckle</td><td>Private</td><td>Lewisburg</td></tr>
<tr><td>Blue Springs</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>Bolling</td><td>Private</td><td>Denmar</td></tr>
<tr><td>Cass</td><td>Private</td><td>Cass</td></tr>
<tr><td>Crawford#1</td><td>Private</td><td>Valley Head</td></tr>
<tr><td>Devils Kitchen</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Dreen</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Friels</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>Grimes</td><td>Private</td><td>Cass</td></tr>
<tr><td>Linwood</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Martens</td><td>Private</td><td>Lobelia</td></tr>
<tr><td>Martha’s</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>McClung</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Piddling Pit</td><td>Private</td><td>Edray</td></tr>
<tr><td>Simmons-Mingo</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Simmons-Mingo</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Tub</td><td>Private</td><td>Hillsboro</td></tr>
</table></td><td></td><td>Present within watershed.</td></tr>
<tr><td>Dry Fork Valley cave beetle</td><td>Pseudanophthalmus montanus</td><td>G1/N1/S1(SOC)</td><td>Twilight zone or deeper in selected caves, in or on moist soil, often near streams or drip areas, often under rocks or debris.</td><td>Known from only four WV caves in Tucker and Randolph Co. The only MNF cave is Cave Hollow/Arbogast Cave, Tucker Co.[30]</td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is</td></tr>
</table>

<table>
<tr><th></th><th>Scientific Name</th><th>Species Rank</th><th>Habitat</th><th>MNF Range</th><th>Likelihood of Occurrence</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>unconfirmed at this time.</td></tr>
<tr><td>Gandy Creek cave springtail</td><td>Pseudosinella certa</td><td>G1/N1/S1</td><td>Clay banks, damp places on or near organic debris in caves. [33]</td><td>Occurs within 5 miles of the Proclamation Boundary in Stillhouse Cave, Randolph Co., Sinks of Gandy quad.[30]</td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>A springtail</td><td>Pseudosinella gisini</td><td>G3G4/N?/S3</td><td colspan="2">Found in damp places on or near bits of organic material in caves. [33, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Allison</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Arbuckle</td><td>Private</td><td>Lewisburg</td></tr>
<tr><td>Buckeye Creek</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Clyde Cochrane Sinks</td><td>Private</td><td>Droop</td></tr>
<tr><td>Friars Hole</td><td>Private</td><td>Droop</td></tr>
<tr><td>Friels</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>Fuells Fruit</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Grimes</td><td>Private</td><td>Cass</td></tr>
<tr><td>Higginbotham’s</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Ludington</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>McClung</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>My Cave</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Piddling Pit</td><td>Private</td><td>Edray</td></tr>
<tr><td>Rapp’s</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>The Hole</td><td>Private</td><td>Anthony</td></tr>
<tr><td>Tub</td><td>Private</td><td>Hillsboro</td></tr>
</table></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>A springtail</td><td>Sinella agna</td><td>G2G3/N2N3/S1</td><td colspan="2">Damp places in caves on or near bits of organic material. [33, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Dreen</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Harper</td><td>Private</td><td>Mozark Mt.</td></tr>
<tr><td>Just</td><td>Private</td><td>Mingo</td></tr>
<tr><td>My Cave</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Piddling Pit</td><td>Private</td><td>Edray</td></tr>
</table></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>Diana fritillary</td><td>Speyeria diana</td><td>G3/N3/S2S3</td><td>Inhabits mountainous areas in WV; prefers moist and well-shaded forest covers with rich soils; utilizes small openings and roadsides in search of nectar plants but will not stray far from woods; usually found nectaring along woodland edges. Nectar sources: milkweeds, thistles, butterfly weed,</td><td>Found in the southern third of the state, south from lower Pocahontas Co., and west to Kanawha and Lincoln Co.; may also occur occasionally in other surrounding counties, as well as the southern counties, with no records to date.[37]</td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
</table>

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
			wild bergamot, Joe-pye-weed and ironweed. Larval host – woodland violets. [37]		
Culver's planarian	*Sphalloplana culveri*	G1/N1/S1	In small streams under rocks and pieces of wood in caves. [33]	Within Proclamation Boundary in Harper Cave, Mozark Mt. Quad, Tucker Co. [30]	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Invertebrates					
Dry Fork Valley cave pseudoscorpion	*Apochthonius paucispinosus*	G1/N1/S1	Damp leaf litter in caves.	Bennett Cave, Mozark Mountain Quad, Tucker Co. (within Proclamation Boundary) [30]	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Cheat Valley Cave Isopod	*Caecidotea cannula*	G2/N2/S1(SOC)	Found under flat rocks in subterranean streams and pools in caves. May also be found in springs flowing out of caves.	Only known to occur in southern Tucker and northern Randolph Counties. MNF caves are Bowden cave* and Cave Hollow/Arbogast cave.	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Holsinger's Valley cave isopod	*Caecidotea holsingeri*	G3/N3/S3	The most common and widespread troglobitic isopod in WV. In cave stream gravel, under rocks, on decaying wood in streams, and occasionally in drip pools.	Only MNF cave known to harbor the species is Bowden cave*, Randolph Co. Also found in Swecker Stream Cave in Pocohontas Co. [30]	Present within watershed.
An isopod	*Caecidotea simonini*	G1/N1/S1	Cave pools. [33, 30]		Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
An isopod	*Caecidotea sinuncus*	G1/N1/S1	Under flat rocks in cave streams [33]	Within Proclamation Boundary,	Based on habitat

Cave	Ownership	Quad
Flower Pot	Private	Whitmer
Stillhouse	Private	Sinks of Gandy

<table>
<tr><th></th><th>Scientific Name</th><th>Species Rank</th><th>Habitat</th><th>MNF Range</th><th>Likelihood of Occurrence</th></tr>
<tr><td></td><td></td><td></td><td></td><td>Blowhole, Keel spring, and Mystic caves, Onego Quad, Pendleton Co. [30]</td><td>requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>A crayfish</td><td>Cambarus nerterius</td><td>G2G3/N2N3/S1</td><td>WV’s only cave crayfish. Generally in subterranean streams, but small specimens have been collected from dry streambeds (but nearly saturated humidity). [28, 29, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Buckeye Creek</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Clyde Cochrane Sinks</td><td>Private</td><td>Droop</td></tr>
<tr><td>Ludington</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Matt’s Black</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>McClung</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>My Cave</td><td>Private</td><td>Mingo</td></tr>
</table></td><td></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>Hoffmaster’s cave planarian</td><td>Macrocotyla hoffmasteri</td><td>G2G3/N2N3/S3</td><td>In first order and small second order streams of caves. [27, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Bazzle</td><td>Private</td><td>Harman</td></tr>
<tr><td>Harper</td><td>Private</td><td>Mozark Mt</td></tr>
<tr><td>Levisay</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>McClung</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Mystic</td><td>Private</td><td>Onego</td></tr>
<tr><td>Piddling Pit</td><td>Private</td><td>Edray</td></tr>
</table></td><td></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
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<tr><th></th><th>Scientific Name</th><th>Species Rank</th><th>Habitat</th><th>MNF Range</th><th>Likelihood of Occurrence</th></tr>
<tr><td>Greenbrier Valley cave millipede</td><td>Pseudotremia fulgida</td><td>G2G3/N2N3/S2</td><td colspan="2">Mud/clay banks in caves; sometimes associated with organic debris. [33, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Allison’s</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Arbuckle</td><td>Private</td><td>Lewisburg</td></tr>
<tr><td>Blue Springs</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>Clyde Cochrane Sinks</td><td>Private</td><td>Droop</td></tr>
<tr><td>Durbin</td><td>Private</td><td>Durbin</td></tr>
<tr><td>Friars Hole</td><td>Private</td><td>Droop</td></tr>
<tr><td>Friels</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>Higginbotham’s</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Hughes Creek</td><td>Private</td><td>Lobelia</td></tr>
<tr><td>Ludington</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Martha’s</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>McClung</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Overholt Blowing</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>Piddling Pit</td><td>Private</td><td>Edray</td></tr>
<tr><td>Poor Farm</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>Poor Farm</td><td>Private</td><td>Denmar</td></tr>
<tr><td>Rapp’s</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Steam</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>The Hole</td><td>Private</td><td>Anthony</td></tr>
</table></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>Germany Valley cave millipede</td><td>Pseudotremia lusciosa</td><td>G1/N1/S1</td><td colspan="2">Mud/clay banks in caves; sometimes associated with organic debris. [33, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Hell Hole</td><td>Private</td><td>Onego</td></tr>
<tr><td>Schoolhouse</td><td>Private</td><td>Upper Tract</td></tr>
<tr><td>Seneca Caverns</td><td>Private</td><td>Onego</td></tr>
<tr><td>Stratosphere Balloon</td><td>Private</td><td>Onego</td></tr>
</table></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>South Branch Valley cave millipede</td><td>Pseudotremia princeps</td><td>G1/N?/S1</td><td colspan="2">Mud/clay banks in caves; sometimes associated with organic debris. [33, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Kenny Simmons</td><td>Private</td><td>Moatstown</td></tr>
<tr><td>Mystic</td><td>Private</td><td>Onego</td></tr>
<tr><td>Peacock</td><td>Private</td><td>Petersburg</td></tr>
<tr><td>Smoke hole</td><td>Private</td><td>Upper Tract</td></tr>
</table></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>Culver’s cave isopod</td><td>Stygobromus culveri</td><td>G1G2/N1N2/S1</td><td colspan="2">Seep and drip pools or in small streams in caves. [33, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Flower Pot</td><td>Private</td><td>Whitmer</td></tr>
<tr><td>Red Run</td><td>FS</td><td>Mozark Mountain</td></tr>
<tr><td>Stillhouse</td><td>Private</td><td>Sinks of Gandy</td></tr>
</table></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
</table>

<table>
<tr><th></th><th>Scientific Name</th><th>Species Rank</th><th>Habitat</th><th>MNF Range</th><th>Likelihood of Occurrence</th></tr>
<tr><td>Greenbrier cave amphipod</td><td>Stygobromus emarginatus</td><td>G3/N3/S3</td><td>In caves under gravel in streambeds and occasionally in pools. Most abundant in smallest trickles of water. Primarily in tiny first and second order headwater cave streams. [27, 35, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Bazzle</td><td>Private</td><td>Harman</td></tr>
<tr><td>Big Springs</td><td>FS</td><td>Parsons</td></tr>
<tr><td>Bonner Pit</td><td>Private</td><td>Mozark Mtn</td></tr>
<tr><td>Bowden</td><td>FS</td><td>Bowden</td></tr>
<tr><td>Clay Pit</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Dreen</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Flower Pot</td><td>Private</td><td>Whitmer</td></tr>
<tr><td>Harper</td><td>Private</td><td>Mozark Mtn</td></tr>
<tr><td>Levisay</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Linwood</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Martha’s</td><td>Private</td><td>Hillsboro</td></tr>
<tr><td>My Cave</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Piddling Pit</td><td>Private</td><td>Edray</td></tr>
<tr><td>Poor Farm</td><td>Private</td><td>Denmar</td></tr>
<tr><td>Rapp’s</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Sharps</td><td>Private</td><td>Mingo</td></tr>
<tr><td>The Hole</td><td>Private</td><td>Anthony</td></tr>
<tr><td>Upper Martha’s</td><td>Private</td><td>Hillsboro</td></tr>
</table></td><td></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>Pocahontas cave amphipod</td><td>Stygobromus nanus</td><td>G1/N1/S1</td><td>Mud bottoms of small streams and seep pools in caves.[33]</td><td>Occurs within Proclamation Boundary in Pocahontas Co., Edray Quad – Piddling Pit cave. [30]</td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>Minute cave amphipod</td><td>Stygobromus parvus</td><td>G1G2/N1N2/S1</td><td>Found in mud-bottomed, drip and seep pools in caves; tolerant of substrate, but prefers standing water. [34, 43]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Bonner</td><td>Private</td><td>Mozark Mt.</td></tr>
<tr><td>Cassell</td><td>Private</td><td>Cass</td></tr>
<tr><td>Crawford #2</td><td>Private</td><td>Valley Head</td></tr>
<tr><td>Piddling Pit</td><td>Private</td><td>Edray</td></tr>
</table></td><td></td><td>Present within watershed. Suitable habitat is found within the watershed.</td></tr>
<tr><td>WV blind cave millipede</td><td>Trichopetalum krekeleri</td><td>G1/N?/S1</td><td>In selected caves, under rocks, around organic debris or on damp silt banks near streams.</td><td>Known from only 5 WV caves. The only MNF cave is Bowden cave*, Randolph Co.</td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this</td></tr>
</table>

<table>
<tr><th></th><th>Scientific Name</th><th>Species Rank</th><th>Habitat</th><th>MNF Range</th><th>Likelihood of Occurrence</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>time.</td></tr>
<tr><td>Grand Caverns blind cave millipede</td><td>Trichopetalum weyeriensis</td><td>G3Q/N3/S2</td><td>Damp areas in caves on organic debris[33, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Arbuckle</td><td>Private</td><td>Lewisburg</td></tr>
<tr><td>Cass</td><td>Private</td><td>Cass</td></tr>
<tr><td>Dreen</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Higginbotham’s</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>Kenny Simmons</td><td>Private</td><td>Moatstown</td></tr>
<tr><td>Linwood</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Ludington</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>McClung</td><td>Private</td><td>Williamsburg</td></tr>
<tr><td>My Cave</td><td>Private</td><td>Mingo</td></tr>
<tr><td>Mystic</td><td>Private</td><td>Onego</td></tr>
<tr><td>The Hole</td><td>Private</td><td>Anthony</td></tr>
</table></td><td></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td>Luray Caverns blind cave millipede</td><td>Trichopetalum whitei</td><td>G2G3Q/N2N3/S1</td><td>Damp areas in caves on or near organic debris.[33, 30]
<table>
<tr><th>Cave</th><th>Ownership</th><th>Quad</th></tr>
<tr><td>Hellhole</td><td>Private</td><td>Onego</td></tr>
<tr><td>Stratosphere Balloon</td><td>Private</td><td>Onego</td></tr>
<tr><td>Trout</td><td>Private</td><td>Sugar Grove</td></tr>
</table></td><td></td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
<tr><td colspan="6">Plants</td></tr>
<tr><td>Fraser fir</td><td>Abies fraseri</td><td>G2/N2/S1(SOC)</td><td>Coniferous tree, generally found above 4500'.</td><td>Known from Blister Run, and Beaverdam Run, Randolph Co. According to Heritage Program records, is not native to WV. All known sites in WV are planted.[36]</td><td>No suitable habitat is found within the watershed.</td></tr>
<tr><td>White monkshood</td><td>Aconitum reclinatum</td><td>G3/N3/S3</td><td>Perennial herb found in mesic northern hardwood forests with acidic bedrock, 2500-4000' elev. Common on NE aspects, especially in coves. In wet but not flooded soil in partial shade, often in a seep at the edge of a road or river where the soil has been worn away (e.g. clay content) by the water moving down the hill. Also along high elevation roads. Most commonly on Cateache soils with Mauch Chunk geology.</td><td>Gay Knob Area (Edray), Chestnut Ridge (Paddy Knob), Spruce Knob Roadside 112 (Spruce Knob), & side slope of Laurel Run (Sharp Knob); occurs in Pocahontas, Randolph, Preston, Pendleton, Grant and Tucker Co.</td><td>Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.</td></tr>
</table>

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
Arctic bentgrass	*Agrostis mertensii*	G5/N?/S1	Open riparian at high elevations. Peaty or rocky soil. [38,46,47]	Known along the upper Shavers Fork above Cheat Bridge on the Mower tract. [30]	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Lillydale onion	*Allium oxyphilum*	G2Q/N2/S2	Odiferous herb with bulb; endemic to acidic shale or sandstone geology mainly on shale barrens.	Found in White Sulphur Springs, & Greenbrier, Pendleton, & Grant Co.	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Spreading rockcress	*Arabis patens*	G3/N3/S2	Moist, rocky woods, limestone outcrops and shady riverbanks	In the Eastern panhandle; Jordan Run Road, Grant Co.; "Dry Trough" Hampshire Co.; Wardensville, Hardy Co.; and Terrapin Neck, Jeff. Co.	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Cooper's milkvetch	*Astragalus neglectus*	G4/N4/S1	Annual herb found on drier, limestone-based soils in the eastern part of the state.	Only known site is on Cave Mt., Grant Co., in what is considered a prairie extant community	Based on habitat requirements and absence of suitable habitat, species is not likely to occur.
Lance-leaf grapefern	*Botrychium lanceolatum*	G5T4/N4/SH	Subarctic and boreal plant of mountain slopes and meadows. Occurs in moist shady woods and margins of swamps. [47]	Collected in Greenbrier, Pocahontas, Preston, Randolph, and Upshur Co. [38]	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Harned's Swamp Clintonia*	*Clintonia alleghaniensis*	__/G1Q/S1	Low herb with umbel, endemic to high elevations of WV and MD above 3500'. Wet inclusions in dry woods or	Known from Blister Swamp, Old Spruce, Second Fork & First Fork Wetland, Pocahontas Co.;	Based on habitat requirements and presence of suitable

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
*This species is designated for removal from the RFSS. It is not recognized by WVNH as a distinct species.			mesic spruce forest. Mt. glades & bogs or swampy woods (particularly where 2 river points come together)(e.g. Warren Run into Gandy Ck.). Riparian areas. Known geology is Pottsville boulders.	Cranesville Swamp, Preston Co.; Big Draft, Kate's Mtn., White Sulphur Springs, Greenbrier Co.; Hunter Fork Creek, Barber Co.; Norton & Bill Bog, Randolph Co.; Laurel Fork Wilderness (N&S), Canaan Valley, Yokum Knob, Narrow Ridge and Blue Knob (near Cranberry Glades Bog).	habitat, species could occur, however, presence is unconfirmed at this time.
Showy lady's slipper	*Cypripedium reginae*	G4/N?/S1	June-Sept. Low, downy, perennial herb occurring in swamps and woods	Rare in WV, known to occur on MNF only near White Sulphur Springs, Greenbrier Co. [38]	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Tall larkspur	*Delphinium exaltatum*	G3/N3/S3(SOC)	Perennial herb found in open limestone woods, mainly in the mountains in the eastern part of the state.	Found at Smokehole in Pendleton Co., Hardy and Greenbrier Co.	Based on habitat requirements and absence of suitable habitat, species is not likely to occur
Shale Barren wild buckwheat	*Eriogonum allenii*	G4/N4/S2	Perennial herb found on the most sterile and barest of sites on shale barrens.	Greenbrier Co.; Ugly Mt., Pendleton Co.	No suitable habitat is found within the watershed.
Darlington's spurge	*Euphorbia purpurea*	G3/N3/S2(SOC)	Annual herb with milky juice found in mountain glades and swampy woods (particularly where 2 river points come together, e.g. where Warner Run flows into Gandy Creek). Possibly mountain bogs, riparian areas. Moist to saturated soils.	Known from Blister Swamp, Pocahontas Co.; Terra Alta, Preston Co.; Laurel Fork, Randolph Co.; Tucker Co.; Canaan Valley, Laurel Fork Wilderness (N&S), McGowan Mt., Cunningham Knob, Yokum Knob, Narrow Ridge, Blue Knob (Cranberry Glades Bog Area).	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Box huckleberry	*Gaylussacia*	G3/N3/S2	Smooth shrub found in acidic sandy	Largest population on border of	Based on habitat

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
	brachycera		soil within submesic forests & on woodland slopes. Under hardwoods, with mixed pine, mt. laurel & other heaths in understory.	GWNF and MNF in the eastern part of the state. In Greenbrier & Pocahontas Co., North Fork Mt., Redman Run Trail & Smokehole.	requirements and absence of suitable habitat, species is not likely to occur
Appalachian oak fern	*Gymnocarpium appalachianum*	G3/N3/S1	Primarily occurs in rocky maple-birch-hemlock woods on mountain slopes and summits, on moist sandstone, talus slopes or bouldery colluvium. Requires a cool, moist microclimate and typically occurs on north-facing slopes with cold air seepage at elevations above 2,000 ft.; occasionally at lower elevations, particularly on the fringes of its range. [39]	Endemic to the Appalachian region, most common in Virginia (the center of its range), where it occurs at 30-100 localities. Pendleton Co. [30]	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
White alumroot	*Heuchera alba*	G2Q/N2/S2	Erect perennial herb found in dry, open woods in the eastern part of the state. Found on sandy soils with Tuscarora sandstone (e.g. North Fork Mt.), on rock outcrops within the woods (Gay Knob, Edray Quad) & on rock outcrops on roadside (Rd. 112, Spruce Knob, Pendleton Co.).	Found in higher elevations of North Fork Mt., Grant Co.; Spruce Knob, Pendleton Co.; Crouch Knob, Randolph Co.; Cass, Pocahontas Co	Present within watershed. Suitable habitat is found within the watershed.
Crested coralroot	*Hexalectris spicata*	G5/N4?/S1	July-Aug. A leafless herb occurring in rich woods.	Smoke Hole, Pendleton Co.; approaching the northern limit of its range. [38]	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Long-stalked holly	*Ilex collina*	G3/N3/S3	Deciduous shrub or tree found in riparian areas along high-energy streamsides at higher elevations. Moist soil; wet meadows and bogs.	Selected sites on Cheat, Greenbrier and Gauley RDs. Along Gauley and Cranberry Rivers	Based on habitat requirements and presence of suitable habitat, species could occur, however,

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
					presence is unconfirmed at this time.
Butternut	*Juglans cinerea*	G3G4/N3N4/S3 (SOC)	Deciduous shade-intolerant tree found in rich loamy soils, mixed hardwood forests, shade intolerant, regeneration in open fields, riparian zones, along ridges, or in edge habitat. Found in association with hawthorn on Greenbrier River shoreline in Greenbrier Co.	From valley to 3200'. Along streams (Laurel & Shavers Forks), & near the Gay Knob area (USFS Road 201) of Randolph Co.; also found in similar areas in adjacent counties. Also found on Landis Trail of North Fork Mt., Pendleton Co., and in Webster Co.	Present within watershed. Suitable habitat is found within the watershed.
Thread rush	*Juncus filiformis*	G/N?/S2	June-Aug. Perennial grass-like herb occurring in bogs	Canaan Valley, elev. 3,000', Tucker Co.; and near Cheat Bridge, Randolph Co. – the southernmost known localities for this species. [38]	No suitable habitat is found within the watershed.
Highland rush	*Juncus trifidus*	G5/N?/S1	Rock crevices and alpine meadows.[47]	Known only from the rocky cliff tops on North Fork Mountain. Global range is Europe and NE America south to mtns. of Virginia and North Carolina. [30, 46]	No suitable habitat is found within the watershed.
Turgid gay feather	*Liatris turgida*	G3/N3/S1	Erect perennial herb in xeric environments associated with clay soils, gravel, shale barrens, & rocky outcrops; can also colonize road cuts. Occurs in shale barrens in WV. Associates include mt. laurel, black gum, red pine, chestnut oak, & sassafras.	(E.g. Slaty Fork TNC Reserve in Monroe Co.) & along roadside (McDowell Co.) White Sulphur Springs, Greenbrier, & Nicholas Co.	No suitable habitat is found within the watershed.
Large-flowered Barbara's buttons	*Marshallia grandiflora*	G2/N2/S2(SOC)	Smooth perennial aster found on sandy or rocky river banks of larger (3rd to 4th order) streams in mountains. Requires hydrology of flood-scouring and full sun, with little competition. Also found in bedrock crevices and sparsely vegetated shores with small stones.	Along the western slopes of Alleghenies. Shaver's Mt., Cheat Mt., Hopkin's Mt., Shaver's Fork, Cherry River, Horse Ridge, Gun Powder Ridge, Huttonsville; Blue Bend (Greenbrier Co.), along lower Gauley River, Nicholas Co.; Cheat River, Preston Co.	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
Bog buckbean	*Menyanthes trifoliata*	G5/N?/S1	April-June. Smooth, perennial marsh herb occurring in bogs and marshy places.	Backbone Mt., Tucker Co.; Cranberry Glades, Pocahontas Co.; historic site at Cranesville, Preston Co. [38]	No suitable habitat is found within the watershed.
Smokehole bergamot	*Monarda fistulosa v. brevis*	G5T1/N1/S1(SOC)	Perennial, aromatic herb found only on limestone-derived communities of Cave Mt. ecosystem including the south branch of Potomac side slopes, cedar glades and rock outcrops.	Cave Mountain	No suitable habitat is found within the watershed.
Canada Mountain rice grass	*Oryzopsis canadensis*	G5/N2/S1	June-July. A perennial grass occurring on sandy barrens	Summit of Panther Knob, Pendleton Co., elev. 4,500', the southernmost station known for the species. [38]	No suitable habitat is found within the watershed.
Canby's Mountain lover	*Pachistima canbyi*	G2/N2/S2(SOC)	Low evergreen shrub found in dry open woods. Calcareous rocks and slopes in the mountains.	Found only in Potomac and New-Kanawha watersheds in Grant, Pendleton and Greenbrier Co.	No suitable habitat is found within the watershed.
Yellow nailwort	*Paronychia virginica v. virginica*	G4/N4/S1(SOC)	Perennial mat-like, wiry plant found on limestone-based rocky cliffs, sandstone banks, crevices along riverbanks, & cedar glades.	Cave Mtn., Eagle Rock & Ship Rock in the Smokehole, Pendleton Co.	No suitable habitat is found within the watershed.
White Mountain Silverling	*Paronychia argyrocoma*		July-Sept. Low perennial herb occurring on White Medina sandstone	New Creek Mt., Grant Co.; Lost River State Park, Hardy Co.; Seneca Rocks, North Fork Mt., Pendleton Co. [38]	No suitable habitat is found within the watershed.
Swamp lousewort	*Pedicularis lanceolata*	G5/N?/S2	Aug.-Oct. Herb occurring in swampy places, often calcareous.	Altona Marsh, Jefferson Co.; Buckeye, Dunmore & Minnehaha Springs, Pocahontas Co.; Sweet Springs, Monroe Co.; near Elkins, Randolph Co. – only known colonies in state. [38]	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
					time.
Sword-leaved phlox	*Phlox buckleyi*	G2/N2/S2	Perennial herb found on shale slopes in eastern woods. Road banks, open woods.	E. Pocahontas Co. near WV55 and WV39, and in Greenbrier Co.	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Jacob's ladder	*Polemonium van-bruntiae*	G3/N3/S2	Perennial herb found in swamps and sphagnum bogs and along riparian zones at higher elevations.	Pocahontas and Preston Co. Southernmost population in Cranberry Glades bog. Also, in Canaan Valley, Tucker Co.	No suitable habitat is found within the watershed.
Tennessee pondweed	*Potamogeton tennesseensis*	G2/N2/S1	Aquatic herb found in standing or slow-flowing shallows of rivers.	Greenbrier, Pocahontas, Preston, and Webster Co.	No suitable habitat is found within the watershed.
Rock skullcap	*Scutellaria saxatilis*	G3/N3/S1	Perennial herb found on wooded rocky hillsides, moist cliffs, 2,500+'; talus slopes/bluffs; moist openings such as riverbanks or talus.	Greenbrier, Pocahontas & Tucker Co.	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Robust fire pink	*Silene virginica v. robusta*	G5T1Q/N1/S1 (SOC)	Narrow endemic perennial herb in dry open woods or riparian areas of Smokehole Rec. Area. Associated with limestone.	Petersburg Gap in Grant and Pendleton Co.	No suitable habitat is found within the watershed.
Ammon's tortula	*Syntrichia*	G1/N1/S1(SOC)	Moss found on wet, cool rock	Falls of Hills Creek, Pocahontas	No suitable habitat is

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
	ammonsiana		outcrops on cliff overhangs adjacent to waterfalls. Sandstone walls.	Co. [40]	found within the watershed.
Appalachian bristle fern	*Trichomanes boschianum*	G4/N4/S1	Delicate fern occurring on dripping rocks. The gametophytes will probably be found in deep shaded recesses of sandstone and quartzite rocks. In the Appalachians it is more common and widespread than the sporophyte, but is overlooked because it resembles a filamentous alga.	Kanawha State Forest, Kanawha Co.; Webster Springs, Webster Co. This represents a northeastern extension of the range of this species. [38]	No suitable habitat is found within the watershed.
Kate's Mountain clover	*Trifolium virginicum*	G3/N3/S3	Perennial, non-stoloniferous clover found on south-facing slopes of very sterile shale barrens and in dry-shale soils.	Eastern portion of the MNF including: Kate's Mt., Greenbrier Co.; Smokehole (above Big Bend campground); Hardy, Nicholas (Devonian shale's), Pendleton Co.	No suitable habitat is found within the watershed.
Nodding pogonia	*Triphora trianthophora*	G3G4/N?/S2	Aug.-Sept. Rich woods, infrequent.	Short Creek, Fayette Co.; Spring Hill, Kanawha Co.; Mt. Lookout, Nicholas Co.; French Creek, Upshur Co.; and Holly River State Park, Webster Co.[38]	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Appalachian blue violet	*Viola appalachiensis*	G/N3/S2	Short perennial stoloniferous herb (mat-forming). Moist floodplains of high-energy streams, alluvial pond shores, old logging roads, and old mounds of up-rooted cherry trees.	Found on all districts. Grant, Hardy, Nicholas, Pendleton, Pocahontas, Preston, Randolph, Tucker, and Webster Co.	Based on habitat requirements and presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Rock grape	*Vitis rupestris*	G3/N3/S1	Brushy, shrub-like grape found climbing on calcareous or gravelly	Found in Grant, Greenbrier, Pendleton and Preston Co	Based on habitat requirements and

	Scientific Name	Species Rank	Habitat	MNF Range	Likelihood of Occurrence
			banks, river bottoms, streambeds, washes, and scoured boulders and cobbles.		presence of suitable habitat, species could occur, however, presence is unconfirmed at this time.
Netted chain fern	*Woodwardia areolata*	G5/N2/S1	Large fern occurring in swamps and wet woods, chiefly in acid soil.	In WV, known only from Clay, Greenbrier, Mineral, Nicholas, Pocahontas, and Upshur counties. Species is distributed principally in the coastal plain and its occurrence in this state suggests that it is a remnant of the Cretaceous flora that occupied the territory prior to the uplift of the Appalachian Plateau.[38]	No suitable habitat is found within the watershed.

Species Rank: US ESA Status/Global Heritage Status/National Conservation Status/ State Status

ESA Status: LE: Legally Endangered
LT: Legally Threatened

Global Heritage Status: G: Global conservation
T: Subspecies, varieties and populations

Global Status		National Conservation Status		State Conservation Status	
GX or TX	Presumed Extinct	NX	Presumed Extirpated	SX	Presumed Extirpated
GH or TH	Historical	NH	Historical, Possible Extirpated	SH	Historical
G1 or T1	Critically Imperiled	N1	Critically Imperiled	S1	Critically Imperiled
G2 or T2	Imperiled	N2	Imperiled	S2	Imperiled
G3 or T3	Vulnerable	N3	Vulnerable	S3	Vulnerable
G4 or t4	Apparently Secure	N4	Apparently Secure	S4	Apparently Secure
G5 or t5	Secure	N5	Secure	S5	Secure
GU or TU	Unrankable	NZ	Zero Occurrences	SZ	Zero Occurrences
G? or T?	Not Yet Ranked	NU	Unrankable	SU	Unrankable
		NR	Reportable	SR	Reported
		N?	Unranked	S?	Not yet ranked
		NA	Accidental	B	Breeding
				N	Non-breeding

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References Cited in Likelihood of Occurrence

1. West Virginia Division of Natural Resources (WVNDR). 1988. Mammals of West Virginia, A Field Checklist. WVDNR, Nongame Wildlife Program, Elkins, WV

2. Stihler, C.W., J.L. Wallace, E.D. Michael and H. Pawelczyk. 1995. Range of *(Glaucomys sabrinus fuscus)*, a federally endangered subspecies of the Northern Flying Squirrel, in West Virginia. In: Proc. WV Acad. Sci; Vol. 67, No. 2,3,4:13-20.

3. U.S. Department of the Interior, Fish & Wildlife Service. 1984. A Recovery Plan for the Ozark Big-eared bat and the Virginia Big-eared bat. USFWL, Region III, Twin Cities, MN. 56 p.

4. U.S. Department of the Interior, Fish & Wildlife Service. Agency Draft 1998. Indiana Bat, Revised Recovery Plan. USFWS, Region III, Minneapolis, MN, 61 p.

5. The Nature Conservancy. 1989. Element Stewardship Abstract for Peregrine Falcon. NC Natural Heritage; Dept. of Natural Resources and Community Development; Division of State Parks and Recreation; Box 27687, Raleigh, NC 27611.

6. The Nature Conservancy. 1989. Element Stewardship Abstract for Southern Bald Eagle. NC Natural Heritage; Dept. of Natural Resources and Community Development; Division of State Parks and Recreation; Box 27687, Raleigh, NC 27611.

7. Pauley, Thomas K. 1994. Surveys of the Cheat Mountain Salamander (*Plethodon nettingi*) in the potential impact area of Corridor H Build and Improved Roadway Alternatives.

8. U.S. Fish and Wildlife Service. 1991. Shale Barren Rock Cress (*Arabis serotina*) Recovery Plan. Newton Corner, MA, 40 pp.

9. West Virginia Natural Heritage Program. 1991. Wildlife Resources Section. The Status of Federally Endangered and Threatened Plant Species in West Virginia.

10. The Nature Conservancy. 1992. Element Stewardship Abstract for Rock Vole. WV Natural Heritage; WVDNR; P.O. Box 67; Elkins, WV 26241

11. The Nature Conservancy. 1992. Element Stewardship Abstract for Eastern Small-Footed Myotis. WV Natural Heritage; WVDNR; P.O. Box 67; Elkins, WV 26241

12. The Nature Conservancy. 1992. Element Stewardship Abstract for Allegheny Woodrat. WV Natural Heritage; WVDNR; P.O. Box 67; Elkins, WV 26241.

13. The Nature Conservancy. 1992. Element Stewardship Abstract for Water Shrew. WV Natural Heritage; WVDNR; P.O. Box 67; Elkins, WV 26241.

14. Clayton, J. WVDNR. Personal communication re green floater. Elkins, WV.

15. Brinker, David F. 1998. Intimidation tactics of a rare bird: The fierce northern goshawk. Wonderful West Virginia. June.

16. Green, N.B. and T.K. Pauley. 1987. Amphibians & Reptiles in West Virginia. Pittsburgh, PA; University of Pittsburgh Press. 241 pp.

17. US Fish & Wildlife Service. Small Whorled Pogonia (*Isotria medeoloides*) Recovery Plan. First Revision. USFWS, Region Five, Newton Corner, MA

18. WVDNR. 1996. Element Stewardship Abstract for the Candy Darter. Elkins, WV 26241

19. WVDNR. 1996. Element Stewardship Abstract for the Kanawha Minnow. Elkins, WV 26241

20. WVDNR. 1996. Element Stewardship Abstract for the Cheat Minnow. Elkins, WV 26241

21. Buckelew, Jr., A.R., and G.A. Hall. 1994. The West Virginia Breeding Bird Atlas. University of Pittsburgh Press.

22. Hall, G.A. 1983. West Virginia Birds. Distribution and Ecology. Special Publication of Carnegie Museum of Natural History, Number 7.

23. Pauley, T. 1994. Known status of the Eastern Hellbender (Cryptobranchus A. alleghaniensis) and the Green Salamander (Aenides aeneus) in the Monongahela National Forest.

24. Cincotta, D.A. WVNDR. 26 Jan. 2000. Letter to Jo Wargo re fish species.

25. Stauffer Jr., J.R., J.M. Boltz, and L.R. White. 1995. The Fishes of West Virginia. Reprinted from Proc. Acad. Nat. Sci. of Phil. 146:1-389

26. Tolin, W. USDA F&W Service. Personal communication re: the green floater, and the Va. northern flying squirrel.

27. Culver, D.C., W.K. Jones, D.W. Fong, and T.C. Kane. 1994. Organ Cave Karst Basin Groundwater Ecology. pp. 451-473. WVDNR Records, Elkins, WV

28. Fitzpatrick, J.F. 1992. Invertebrate Characterization Abstract (Global) *Cambarus nerterius.* WVDNR Nongame Wildlife & Natural Heritage Program files, Elkins, WV

29. Jezerinac, R. F.; G.W. Stocker and D.C. Tarter. 1995. Crayfishes (Decapoda; Cambaridae) of West Virginia. Ohio Biol. Surv. Bull. New Series. Vol. 10 No. 1. X+193p.

30. Element Occurrence Log Sheet. WVDNR Nongame Wildlife & Natural Heritage Program files, Elkins, WV Individual log sheets included: *Apochthonius paucispinosus; Caecidotea simonini; Cambarus nerterius; Gymnocarpium appalachianum; Pseudanophthalmus fuscus; Pseudanophthalmus hadenoecus; Pseudanophthalmus hypertrichosis; Pseudosinella certa; Pseudosinella gisini; Pseudotremia fulgida; Pseudotremia lusciosa; Pseudotremia princeps; Sinella agna; Stygobromus culveri; Stygobromus emarginatus; Stygobromus nanus; Stygobromus parvus; Trichopetalum weyeriensis; Trichopetalum whitei*. (19 Jan 2000). *Agrostis mertensii*; *Aenides aeneus*; *Caecidotea sinuncus*; *Fontigens tartarea*; *Juncus trifidus*; *Macrocotyla hoffmasteri; Pseudanophthalmus montanus*; *Sphalloplana culveri.* (3/14/00).

31. Schweitzer, D.F. 1991. Invertebrate Characterization Abstract (Global) *Pseudanophthalmus hadenoecus.* WVDNR Nongame Wildlife & Natural Heritage Program files, Elkins, WV

32. Schweitzer, D.F. 1991. Invertebrate Characterization Abstract (Global) *Pseudosinella certa.* WVDNR Nongame Wildlife & Natural Heritage Program files, Elkins, WV

33. Holsinger, J. 14 March 2000. Personal communication.

34. Fitzpatrick, J.F. 1993. Invertebrate Characterization Abstract (Global) *Stygobromus parvus.* WVDNR Nongame Wildlife & Natural Heritage Program files, Elkins, WV

35. Holsinger, J.R. Section V. Biology. WVDNR Records, Elkins, WV

36. Beck, D.E. 1990. Abies fraseri Fraser Fir. In: Silvics of North America. Vol. I, Conifers. USDA FS Agr. Handbook 654. pp. 47-51

37. Allen, T.J. 1997. The Butterflies of West Virginia and Their Caterpillars. University of Pittsburgh Press, Pittsburgh, PA 15261

38. Strausbaugh, P.D., and E.L. Core. 1977. Flora of West Virginia. Second Edition. Seneca Books, Inc., Morgantown, WV

39. Pryer. 1997. Plant Characterization Abstract (Global) *Gymnocarpium appalachianum.* WVDNR Nongame Wildlife & Natural Heritage Program files, Elkins, WV

40. Risk, A.C., and J. Kiser. 1991. Report on a survey of the Falls of Hills Creek Scenic Area for Tortula Ammonsiana. Dept. of Biological and Environmental Sciences, Morehead State University, Morehead, KY.

41. Stihler, C. 6 January 2000. Letter to Lynette Otto. WVNDR, Elkins, WV.

42. Stihler, C. 1999. Note to J. Wargo. WVDNR, Elkins, WV.

43. Hosinger, J.R., R.A. Baroody, and D.C. Culver. 1976. The Invertebrate Cave Fauna of West Virginia; Bulletin 7; WV Speleological Survey.

44. The Nature Conservancy. Element Stewardship Abstracts for: Shale Barren Rockcress, Hellbender, Indiana Bat, Greenbrier Valley Cave Isopod, Blind Cave Millipede, Organ Cave snail, Cheat Valley Cave Isopod, Dry Fork Valley Cave Beetle, Running Buffalo Clover, Darlington's Spurge, Rock Skullcap, Jacob's Ladder, Kate's Mountain Clover.

45. Stihler, C. WVDNR. Personal communications regarding Allegheny woodrat, Indiana and Virginia big-eared bats, Virginia northern flying squirrel.

46. McDonald, B. March 2000. Personal communication. Natural Heritage Program, WVDNR, Elkins, WV

47. Gleason, H.A. and Conquist A. 1991. The manual of Vascular Plants of Northeastern U.S. and Adjacent Canada. New York Botanical Garden.

48. The Smithsonian Book of North American Mammals. 1999. D.E. Wilson and S. Ruff ed.

49. Lee, D.S., C.R. Gilbert, C.H. Hocutt, R.E. Jenkins, D. E. McAllister and J.R. Stauffer, Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State museum of Natural History. Publication #1980-12 of the North Carolina Biological Survey.

50. Degraaf, R.M., and D.D. Rudis 1981. Forest habitat for Reptiles and Amphibians of the Northeast. Northeastern Forest Experiment Station. R9-35-9-15-RRWL.

References Used For Rational

Chipps, S.R., Perry S.A., and W.B. Perry. 1993. Status of sensitive fish species in selected streams in the Monongahela National Forest. West Virginia University, Morgantown, WV.

Conant, R. 1975. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Second Edition, Houghton, Mifflin Company, Boston.

Federal Register, Tuesday, November 15, 1994. Part IV, Department of the Interior, Fish and Wildlife. 50 CFR Part 17. Endangered and Threatened Wildlife and Plants; Animal Candidate Review for Listing as Endangered or Threatened Species; Proposed Rule.

Harmon. P.J. Final Report: Rare plant study of the Gauley Ranger District. WV Natural Heritage Program. Div. of Natural Resources, Elkins, WV.

NatureServe Explorer: An online encyclopedia of life [web application]. 2001. Version 1.6. Arlington, VA USA: NatureServe. Available: http://www.natureserve.org/explorer.

Sargent, B., WVDNR, Natural Heritage - Personal communication regarding Natural Heritage database for ETS occurrences in project areas.

USDA FS – R9 Regional Sensitive Species list. Technical update with database. Signed by B. Jacobs, March, 2000.

USDI Fish and Wildlife Service. Recovery Plans for: Indiana Bat, Appalachian Northern Flying Squirrels, Cheat Mountain Salamander, Virginia Big-eared Bat, Peregrine Falcon, Eastern Cougar, Running Buffalo Clover, Small-Whorled Pogonia, Virginia Spirea, Shale Barren Rock Cress.

Vertebrate Species of Concern in WV: Green salamander, page 41A; Northern goshawk, page 69A; Bald eagle, page 72A; Peregrine falcon, page 73A; Small-footed myotis, page 91A; Virginia Big-eared bat, page 95A